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Farmland Industries, Inc., Phosphate Mine
Hardee County, Florida

(U.S.) Environmental Protection Agency
Atlanta, GA

May 81

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Farmland Industries, Inc. has proposed an open pit phosphate mine and beneficiation plant on a 7810-acre site in west central Hardee County, Florida. Mining and processing will involve 5280 acres, all of which will be reclaimed, and will produce 2 million tons of phosphate rock per year for 20 years. The EIS examines alternatives, impacts and mitigative measures related to air, geology, radiation, groundwater, surface water, ecology and other natural and cultural systems.

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Environmental Impact Statement

Draft

Farmland Industries, Inc. Phosphate Mine Hardee County, Florida

PRODUCT OF:
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET
ATLANTA, GEORGIA 30365

May 29, 1981

REF: 4SA-EIS

TO: ALL INTERESTED GOVERNMENTAL AGENCIES, PUBLIC GROUPS, AND CONCERNED INDIVIDUALS.

The Draft Environmental Impact Statement for the Farmland Industries Phosphate Mine and Beneficiation Plant is enclosed for your review. This document has been prepared pursuant to Section 102(2)(c) of the National Environmental Policy Act (NEPA) (Public Law 91-190) and applicable EPA regulations at 40 CFR Part 6.9. A Supplemental Information Document (in two volumes) has also been prepared which contains the supporting data related to the EIS. While the Draft EIS is a complete document, much of the technical detail has been presented in the Supplemental Information Document (SID) to reduce the length of the DEIS, to make the DEIS more analytical than encyclopedic, and to make the DEIS more understandable to the non-technical public. The Draft EIS and the SID may be reviewed at the following locations:

Lakeland Public Library, Lakeland, Florida
Bartow Public Library, Bartow, Florida
Ausley Memorial Library, Wauchula, Florida
DeSoto County Public Library, Arcadia, Florida
Selby Public Library, Sarasota, Florida
Manatee County Library System, Bradenton, Florida
Tampa-Hillsborough County Public Library,
Tampa, Florida
Punta Gorda Public Library, Punta Gorda, Florida

A public hearing to discuss this project has been scheduled for July 14, 1981, at 7:00 p.m. in the Hardee County Agricultural and Civic Center, located at Altman Road and Stenstrom Road in Wauchula, Florida. Persons may begin to register at 6:30 p.m.

Persons wishing to make comments should attend and speak at the hearing. A verbatim transcript will be made of this public hearing. The hearing chairman may request that lengthy or technically complex statements be summarized and that, to ensure accuracy of the record, such statements be submitted in writing to:

Ms. A. Jean Tolman
EIS Project Officer
Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365

The hearing record will remain open and additional written comments may be submitted through July 28, 1981. Such additional comments will be considered as if they had been presented at the public hearing.

Recipients of this document should be aware that EPA will not reprint the material contained in the DEIS for the Final EIS. The Final EIS will consist of the Agency's statement of findings, any pertinent additional information or evaluations developed since publication of the Draft EIS, comments on the project and the Agency responses and the transcript of the public hearing.

Please bring this notice to the attention of all persons who may be interested in this matter.

Sincerely yours,

Rebecca W. Hanmer

Rebecca W. Hanmer
Regional Administrator

Enclosure: DEIS

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

for

Proposed Issuance of a New Source National Pollutant Discharge Elimination System Permit

to

Farmland Industries, Incorporated
Phosphate Mine
Hardee County, Florida

prepared by:

U.S. Environnmental Protection Agency
Region IV, Atlanta, Georgia 30365

cooperating agency:

U.S. Army Corps of Engineers
Jacksonville District
Jacksonville, Florida 32201

Farmland Industries, Inc. has proposed an open pit phosphate mine and beneficiation plant on a 7810-acre site in west central Hardee County, Florida. Mining and processing will involve 5280 acres, all of which will be reclaimed, and will produce 2 million tons of phosphate rock per year for 20 years. The EIS examines alternatives, impacts and mitigative measures related to air, geology, radiation, groundwater, surface water, ecology and other natural and cultural systems.

Comments will be received until July 28, 1981.

Comments or inquiries should be directed to:

A. Jean Tolman, EIS Project Officer
U.S. Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365
(404) 881-7458

approved by:

Rebecca W. Hanmer
Rebecca W. Hanmer
Regional Administrator

May 12, 1981
Date

Summary Sheet
for
Environmental Impact Statement

Farmland Industries, Inc.

Phosphate Mine

(X) Draft
( ) Final

U.S. Environmental Protection Agency, Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365

1. Type of Action: Administrative (X) Legislative ( )

2. Description of Action:

Farmland Industries, Inc. is proposing to construct and operate a phosphate mine and beneficiation plant in Hardee County, Florida. The EPA Region IV Administrator has declared the proposed facilities to be a new source as defined in Section 306 of the Federal Clean Water Act.

In compliance with its responsibility under the National Environmental Policy Act (NEPA) of 1969, EPA Region IV has determined that the issuance of a new source National Pollutant Discharge Elimination System (NPDES) permit to the proposed mining and beneficiation facility would constitute a major Federal action significantly affecting the quality of the human environment. Therefore this Environmental Impact Statement has been prepared in accordance with the requirements of NEPA and EPA regulations at 40 CFR Part 6.

Farmland's proposed mine operation is planned to produce 2 million tons per year of wet phosphoric rock over the 20-year life of the mine. Approximately 4951 acres of the 7800-acre site would be mined, with an additional 329 to be occupied by other facilities such as the beneficiation plant. During the life of the mine, all of the rock mined from the tract will be shipped to existing fertilizer plants for conversion to finished fertilizer, with approximately 50 percent of the tonnage going to Farmland's existing phosphate fertilizer manufacturing facility at Green Bay, Florida. Farmland currently and historically has bought the phosphate rock processed at their Green Bay plant from other producers. Farmland states that the proposed mine is needed to stabilize their phosphate rock supply.

The initial phase of the proposed activity will be land clearing and open burning in advance of the mine. The cleared acreage in front of the mining operation will be about 20 acres. The mining operation will employ a single large dragline supplemented, beginning in year 10, by a second, smaller dragline. The mined matrix will be slurried and transported via pipeline to the beneficiation plant for washing to separate pebble product, clay, and fines, and for flotation to recover additional product. The wet rock will be stored temporarily at the plant. Farmland plans to construct an 8000-foot long railroad spur, linking the plant with the Seaboard Coast Line Railroad, and rail ship the wet rock product to receiving phosphate fertilizer plants.

The proposed waste sand and clay disposal plan will employ the sand-clay mix technique. Limited conventional disposal will be required to store these wastes until the sand-clay mix procedure becomes operational and to periodically store waste generated in excess of the sand-clay mix requirements and capabilities. Conventional Settling Area I (495 acres) will be constructed on unmined land and utilized during the first 5 years of mining, after which time the stored clays will be removed (and used for sand-clay mix) and the ground beneath will be mined. Settling Area II (583 acres) will be used as early as year 2 of operation and remain active for the life of the mine. Sand-clay mixing can begin in the fourth year of mine operation and continue for the mine life, ultimately creating 3915 acres of sand-clay mix areas, or 79 percent of the total mined area.

The proposed mining operation requires water for matrix transport and processing equivalent to a flow rate of 50,000 gpm (72 mgd). The proposed water management plan incorporates extensive recycling of process water to minimize water consumption. The mine water recirculation system, the clay settling areas, active sand-clay mix areas, and return water ditches act as a water clarification system, returning decanted water to the clear water pond. Clear water is then recirculated to the mine and to the beneficiation plant. Recycle water is reused many times before being lost to the waste or phosphate products as entrained water. Actual freshwater use will be about 8.83 mgd, most (6.02 mgd) of which is required for the amine flotation section of the beneficiation plant. The additional amount will be required for make-up to replace water losses within the recirculating system.

The proposed reclamation plan is based on the use of a waste sand-clay mix material as backfill over most of the mined area (3915 of the 5169 acres mined). The proposed plan is designed to return the site to a land form and use compatible with the surrounding area, which is primarily agricultural. The reclaimed site will consist primarily of improved pasture, restored marshes, lakes, and areas (totalling 2530 acres) to be preserved by Farmland (e.g., Oak Creek Islands). Following reclamation, the acreage of forested uplands, freshwater marsh, improved pasture, and lakes will increase, while the acreages of freshwater swamp, pine flatwoods-palmetto range, and citrus will decrease.

3. Alternatives Considered:

Farmland has developed an integrated plan for the mining and processing of phosphate rock at their Hardee County mine. This plan is comprised of a number of individual components linked so as to provide a total project capable of meeting Farmland's goals. The identifiable components included in the Farmland project are as follows:

- Mining
- Matrix Transport
- Matrix Processing
- Waste Sand and Clay Disposal
- Process Water Source
- Water Management Plan
- Reclamation

Various methods (i.e., alternatives) are available to satisfy the objectives of each of these components. These are summarized below:

Component	Objective	Alternatives Considered
Mining	Remove overburden and deliver matrix to a transport system.	Dragline Mining*, Dredge Mining, and Bucketwheel Mining.
Matrix Transport	Transport matrix from the mine to the beneficiation plant.	Slurry Matrix Transport*, Conveyor Transport, and Truck Transport.
Matrix Processing	Process the matrix to separate the phosphate rock product from the waste sand and clay.	Conventional Matrix Processing* and Dry Matrix Processing.
Waste Sand and Clay Disposal	Dispose of the waste sand and clay generated by matrix processing.	Sand-Clay Mixing* and Conventional Sand and Clay Disposal.
Process Water Sources	Provide a continuous source of freshwater (about 8.83 mgd) for use in matrix processing and as make-up for losses to the recirculating system.	Groundwater Withdrawal* and Surface Water Impoundment.

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*Farmland's proposed action.

Component	Objective	Alternatives Considered
Water Management	Provide a means to reduce the amount of water in the recirculating system.	Discharge to Surface Waters* and Use of Connector Wells.
Reclamation	Return the mined site to useful productivity.	Farmland's Reclamation Plan, Conventional Reclamation, and Natural Mine Cut Reclamation

A brief description of each of the alternatives listed above as well as the no action alternative is presented in the following paragraphs.

Mining

Dragline Mining. Farmland proposes to use a single large (45-cu yd) dragline to move overburden and mine matrix during the first 9 years of operation. In year 10 a second smaller (20-cu yd) dragline would be added to supplement the larger unit. Other than the fact that Farmland proposes to initially mine with a single large dragline (rather than two smaller units), the proposed mining method is as conventionally practiced in the Florida phosphate industry.

Dredge Mining. The three most common dredge types are the bucket line, cutter head, and bucketwheel. Each is basically a large, barge-mounted machine consisting of a continuous digging apparatus mounted on a long boom extending below the water surface. The bucket line's chain carried buckets continuously transfer material up to the barge, while the other two units pump material from beneath the water to the surface via a suction pipe.

Bucketwheel Mining. Bucketwheel excavators are large continuous mining machines which excavate material with a series of buckets mounted on the periphery rotating wheel and drop it onto a conveyor belt system. Overburden would be routed for disposal in previously mined areas, while matrix would be sent to the beneficiation plant.

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*Farmland's proposed action.

Matrix Transport

Slurry Matrix Transport. Slurry matrix transport is used at most existing Florida phosphate mines. Matrix would be placed into a slurry pit and mixed with recycled water (17,720 gpm) from high pressure nozzles, breaking down the clay and sand matrix into a 26 percent solids slurry which would then be transported via pipeline to the beneficiation plant by a series of large pumps operating at about 19,400 gpm.

Conveyor Matrix Transport. Conveyor matrix transport would require that matrix be placed onto a belt conveyor at the mine for transport to the beneficiation plant. In order to minimize the number of transfer points and still maintain mobility of the conveyor sections, such a conveyor belt system would most likely include belt sections of up to 2000 feet in length.

Truck Matrix Transport. A dragline would load the trucks, which would then transport the matrix via haul roads to the beneficiation plant. At the plant matrix would be dumped and/or washed out of the trucks.

Matrix Processing

Conventional Matrix Processing. Conventional matrix processing involves the separation of phosphate rock from waste sand and clay using a series of wet-process operations. These consist of washing, feed preparation, and flotation. This is the only method of matrix processing in operation in the Florida phosphate industry today.

Dry Matrix Processing. The general concept of dry processing involves the production of usable phosphate product from matrix--directly following its excavation and drying. The method utilized would probably involve both air separation and electrostatic separation. There are no such plants in operation in the Florida phosphate industry today.

Waste Sand and Clay Disposal

Sand-Clay Mixing. Sand-clay mixing involves the recombining of the waste sand and clay removed from the phosphate matrix during separate processing steps in areas surrounded by dikes 17-20 feet high. No specific technique has been proposed by Farmland for creating such a mixture, but the supply of sand and clay in the matrix should be sufficient to allow development of a technique. Farmland has committed to do this once operation begins.

Conventional Sand and Clay Disposal. Conventional methods for disposing of the waste sand and clay removed from the phosphate matrix during processing involve their impoundment in separate areas surrounded by dikes as high as 41 feet above-grade. More than half of the area to be mined would be covered with waste clays impounded to a height of 35 feet above-grade and surrounded by such dikes.

Process Water Sources

Groundwater Withdrawal. The major source of freshwater used at the mine would be from onsite deep (1400 foot) wells. The mine field would likely consist of a primary production well, standby production well, and a potable water well. The production well would have a capabity of 6200 gpm, with the average daily pumping rate being about 5075 gpm.

Surface Water Impoundment. The most readily available freshwater source which could be utilized by Farmland would be surface water from nearby creeks and rivers. Since the creeks on the site typically exhibit low flows, or even intermittent flows, the quantity available for use as process water could be best provided by impoundment within a reservoir system constructed on the site.

Water Management Plan

Discharge to Surface Waters. Seasonal changes in rainfall and evaporation rates will affect the active water volume of the recirculating water system. When heavy rainfall occurs, the system may become overloaded, forcing a discharge to an existing natural drainage (either Hickory Creek or Oak Creek) through a control structure.

Use of Connector Wells. Connector wells would serve to reduce the amount of water in the recirculating system by dewatering the Surficial Aquifer (a source of water inflow to the system) in the vicinity of the active mine pit. This water would be pumped downward through wells into a deeper aquifer and serve as a source of recharge to that aquifer.

Reclamation Plan

Farmland's Proposed Reclamation Plan. Farmland's proposed reclamation plan consists of five general types of restoration. These are generally described as follows:

Sand-Clay Mix Landfills	- 3915 acres
Crust Development on Clay Settling Areas	- 583 acres
Sand Tailings Landfills	- 104 acres
Land and Lakes Areas	- 567 acres
Disturbed Natural Ground	- 111 acres

Reclamation will proceed over the life of the mine, with the final areas being mined reclaimed in the 24th year after operation begins.

Conventional Reclamation. Conventional reclamation is reclamation associated with the separate disposal of sand and clay wastes (i.e., conventional sand and clay waste disposal). Reclamation would consist of allowing a crust to form over the more than 2500 acres of impounded clays and seeding these areas with forage species, and creating extensive land and lakes areas in those areas of the site not covered with impounded clays. The revegetation of these areas would likely consist of forage species plantings on most land areas, with forest tree plantings along the edges of the lakes.

Natural Mine Cut Reclamation. Natural mine cut reclamation would amount to leaving mined-out areas in windrows, with sand-clay mix deposited between windrows. Mined areas would be allowed to revegetate naturally, as has been the case in many of the older central Florida mines. The resultant use of the mined-out land would be largely for fish and wildlife habitat, with some pastureland.

The No Action Alternative

The no action alternative by EPA would be the denial of an NPDES permit for the proposed project. The effect of permit denial would be to precipitate one of three possible reactions on the part of Farmland: (1) termination of their proposed project; (2) indefinite postponement of the proposed project; or (3) restructuring of the project to achieve zero discharge, for which no NPDES permit would be required.

Termination of the planned project would allow the existing environment to remain undisturbed and the gradual socioeconomic and environmental trends would continue as at present.

If EPA were to deny Farmland's NPDES permit application, the project might be postponed for an indefinite period of time and then successfully pursued by either Farmland or another mining company. This might be expected to occur when high grade phosphate reserves are depleted and the resource retained on the Farmland site becomes extremely valuable strategically as well as economically.

If EPA denies the NPDES permit, Farmland could still execute a mining project provided the project could be performed with zero discharge to surface waters. Under zero discharge conditions, neither an NPDES permit nor an Environmental Impact Statement would be required.

4. Mitigation Measures:

Mitigation measures which would serve to reduce the impacts which the project will have on the surrounding environment were developed from inputs received from the preparers of the various sections of the Environmental Impact Statement. These are described below:

- Pile overburden such that the volume available for below ground waste disposal is maximized.
- Use "toe spoiling" to reduce the radioactivity of reclaimed surface soils.
- Cover reclaimed sand-clay mix disposal areas with about 6 inches of low activity soil to reduce gamma radiation levels.
- Cover reclaimed clay disposal areas with 10-15 ft of overburden to reduce gamma radiation levels.
- Use treated mine water, rather than Surficial Aquifer water, for pump seal lubrication.
- Divert Hickory Creek around the mining area to its preserved lower portion, rather than to Troublesome Creek.
- Restrict mining along the preserved lower portion of Hickory Creek to only one side of the stream channel at a given time.
- Monitor the Surficial Aquifer in the vicinity of sand-clay mix disposal areas.
- Increase the acreage to be reclaimed as forest habitat and provide corridors for wildlife movement between reclaimed and preserved areas by planting additional areas with trees.
- Establish a 7- to 10-acre littoral zone at the downstream end of the lake system proposed for reclamation of the Hickory Creek channel.
- Increase the acreage to be reclaimed as marsh by 116 acres.
- Implement a program to reduce impacts on the indigo snake, a threatened species which occurs on the site.

5. EPA's Preferred Alternatives and Recommended Mitigating Measures:

The alternatives evaluation for the Farmland project is presented in Section 2.0 of the EIS. Based on analyses described in this section, EPA's preferred alternative for each of the project components is as follows:

Project Component	EPA Preferred Alternative
Mining	Dragline Mining
Matrix Transport	Slurry Matrix Transport
Matrix Processing	Conventional Matrix Processing
Waste Sand and Clay Disposal	Sand-Clay Mixing
Process Water Source	Groundwater Withdrawal
Water Management Plan	Discharge to Surface Waters
Reclamation	Farmland's Proposed Reclamation Plan

As indicated above, EPA's preferred alternatives for the various project components are in agreement with Farmland's proposed action. However, implementation of most of the mitigation measures described in the previous section is proposed as a condition of the NPDES permit for the project. The measures excluded as conditions of the permit are the capping of waste disposal areas with low activity overburden and the use of treated mine water to meet pump seal requirements. While environmental impacts might be reduced by capping of waste disposal areas, this is considered to be impractical on the scale of the proposed mine--both for economic and technical reasons.

The withdrawal of Surficial Aquifer water to supply pump seal requirements represents only 6 percent of the minimum groundwater withdrawal for the proposed project. In addition, water will be withdrawn, in most instances, from areas which will eventually be mined--totally destroying the Surficial Aquifer itself, at least in the short term. Therefore, the economic costs and technical difficulties which treatment of mine water would pose to Farmland are not considered justified.

All other mitigation measures listed in Section 4 are proposed as conditions of the NPDES permit for the Farmland project.

6. Summary of the Environmental Impacts of the Alternatives:

A summary of the environmental impacts of the alternatives is provided in Table 1 so that the impacts of Farmland's proposed action, EPA's preferred alternatives and mitigating measures, and the no action alternative can be evaluated comparatively.

7. EPA's Proposed Action

Pursuant to provisions of the Clean Water Act of 1977, EPA proposes to issue a NPDES permit to Farmland for their proposed Hardee County, Florida phosphate mine. The proposed permit will impose as permit conditions the performance of all mitigating measures identified in Farmland's proposed action as well as those additional mitigating measures developed by EPA which were recommended for implementation.

Table 1. COMPARISON OF THE ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES.

Discipline	Farmland's Proposed Action	EPA'S Preferred Alternatives and Mitigating Measures	The No Action Alternative		
			Termination	Postponement	Achieve Zero Discharge
Air Quality, Meteorology, and Noise	Minor increases in fugitive dust emissions and emissions from internal combustion engines; minor emissions of volatile reagents; increased noise levels in the vicinity of operating equipment.	Same as Farmland's proposed action.	No change in meteorology & noise levels present; possible air quality changes from other sources.	Same as Farmland's proposed action.	Same as Farmland's proposed action.
Geology and Soils	Disruptions of the surface soils and overburden strata over the mine site; depletion of 40 million tons of phosphate rock resources; creation of a reclaimed soil material which should be superior to existing soils.	Same as Farmland's proposed action, except that the height of the remaining waste clay impoundment could be reduced by about 4 feet by piling overburden to greater heights.	No change in geology; no change in site soils (i.e., increased productivity); preservation of 40 million tons of phosphate rock reserves.	Possible increased phosphate recovery and more effective sand-clay mix disposal, reclamation, and wetlands restoration.	Increased dike heights, and water storage capacity; probable infringement on preserved areas; less desirable reclamation plan.
Radiation	Disruption of the natural distribution of radioactive material within the overburden and phosphate matrix; increased radiation levels from reclaimed surfaces.	Same as Farmland's proposed action, except that reclaimed surface soils would contain less radioactive material because of toe spoiling.	No change in radiation characteristics of the site.	Same as Farmland's proposed action.	Probable increase in area covered with waste clays--the reclaimed material having the highest radioactivity levels.
Groundwater	Withdrawal of groundwater from the Floridan Aquifer at an average rate of 8.83 mgd; lowering of Surficial Aquifer in the vicinity of active mine pits; possible local contamination of Surficial Aquifer adjacent to sand-clay mix disposal areas.	Same as Farmland's proposed action.	No change in existing groundwater quantity and quality.	Possible reduction in groundwater withdrawals because of more effective dewatering of waste materials.	Same as Farmland's proposed action.
Surface Water	Disruption of surface water flows from the mine site; minor reduction in flows following reclamation; degradation of water quality due to discharges from the mine water system.	Same as Farmland's proposed action, except that flow would be maintained in lower Hickory Creek, instead of increasing flow in Troublesome Creek; and there would be reduced loss of baseflow to Hickory Creek in years 12-13.	No change in surface water quantity; surface water quality would be dependent upon future land uses in the site area.	Same as Farmland's proposed action.	Elimination of surface water quality impacts resulting from discharge from mine water system; increased probability of dike failure impacts.
Aquatic Ecology	Destruction of aquatic habitats on the mine site; aquatic habitat modifications due to reduced surface water flows and addition of contaminants to creeks flowing from the site.	Same as Farmland's proposed action, except that the impacts on aquatic biota in Hickory Creek will be lessened by the continuation of flow through its preserved lower portion.	No change in existing aquatic ecology.	Same as Farmland's proposed action.	Elimination of habitat modification resulting from discharge from mine water system; increased probability of dike failure impacts.
Terrestrial Ecology	Destruction of terrestrial habitats and loss of individuals of some species on the mine site; creation of modified habitats following reclamation.	Same as Farmland's proposed action, except that the wildlife habitat on the reclaimed mine site will be more extensive (both marsh and forest).	No change in existing terrestrial ecology.	Possibly more effective reclamation and wetlands restoration.	Probable creation of increased reclaimed land areas (waste clays) of limited use (e.g., pasture).
Socioeconomics	Generation of jobs with comparatively high incomes; ad valorem and sales tax revenue for Hardee County; severence tax revenue for the state, Land Reclamation Trust Fund, and Florida Institute of Phosphate Research; some population influx to Hardee County; increased demands for housing, transportation, fire protection, police, and medical services.	Same as Farmland's proposed action.	Loss of jobs which would be generated by the project; loss of tax revenue for Hardee County and the State; less demand for transportation, housing, fire protection, police and medical services; continuation of phosphate rock market uncertainties for Farmland and a loss of their investment.	Continuation of phosphate rock market uncertainties for Farmland and potential increased project costs; possible improvement in supply/demand for housing in Hardee County.	Same as Farmland's proposed action.

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1.0

PURPOSE AND NEED FOR ACTION

Farmland Industries, Inc. (Farmland) is a regional manufacturing, distribution, and marketing cooperative which provides a variety of services to some 1/2 million midwestern U.S. farm and ranch family member-owners. One of the primary services of the cooperative is the manufacture and distribution of fertilizers to its member-owners.

Farmland currently manufactures phosphate fertilizers in an existing facility at Green Bay, Florida. The rock raw material for this facility has historically and is currently being bought from other mining companies in central Florida. During this history of the Green Bay facility, there have been times when Farmland has been unable to secure sufficient raw materials to operate this plant at its capacity and has therefore been unable to supply the necessary fertilizer to its member-owners. This has been particularly true during periods when heavy export demand has drained off both rock and fertilizer supplies from the domestic market. In order to prevent this situation from recurring, Farmland has proposed to construct and operate a 2 million ton per year wet phosphate rock mine in Hardee County, Florida (Figure 1-1). The development, located near Ona, will result in the disturbance of about 5000 acres of the 7800-acre tract which comprises Farmland's Hardee County reserve. During the 20+ year life of the mine, all of the rock mined from the tract will be shipped to existing fertilizer plants for conversion to finished fertilizer, with approximately 50 percent of the tonnage going to Farmland's existing Green Bay facility.

The U.S. Environmental Protection Agency (EPA) has determined that Farmland's proposed phosphate mining operations will constitute a "new source" discharge facility under the Federal Clean Water Act of 1977 (FCWA), as amended. As a new source, the proposed Farmland operations will be subject to the National Pollutant Discharge Elimination Systems (NPDES) new source effluent limitations and permit requirements.

In accordance with the FCWA, the issuance of a new source NPDES permit by the U.S. EPA will represent a major federal action and require compliance with the provisions of the National Environmental Policy Act of 1969 (NEPA). The U.S. EPA Regional Administrator determined that the issuance of the NPDES permit for the proposed Farmland mine would significantly affect the quality of the human environment. NEPA requires that all federal agencies prepare detailed environmental impact statements (EIS's) on proposed major federal actions significantly affecting the quality of the human environment. Therefore, the U.S. EPA is required by the NEPA process to prepare a detailed site-specific EIS on the phosphate mine proposed by Farmland in Hardee County, Florida.

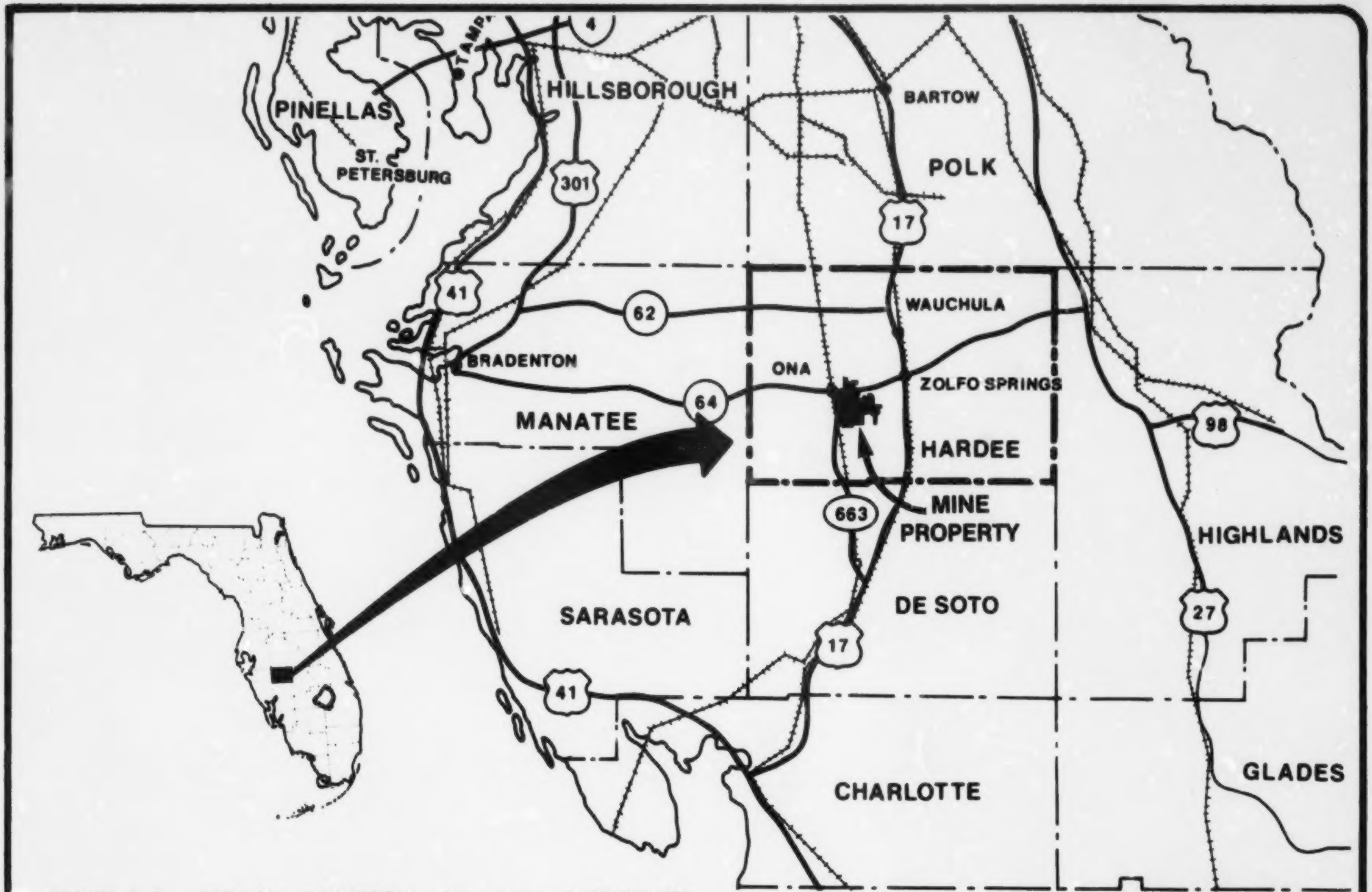


FIGURE 1-1. FARMLAND INDUSTRIES, INC. SITE LOCATION MAP.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

2.0

ALTERNATIVES INCLUDING THE PROPOSED ACTION

Farmland has developed an integrated plan for the mining and processing of phosphate rock at their Hardee County mine. This plan, hereafter referred to as Farmland's proposed action, is comprised of a number of individual project components linked so as to provide a total project capable of meeting Farmland's goals. The identifiable components included in the Farmland project are as follows:

- Mining
- Matrix Transport
- Matrix Processing
- Waste Sand and Clay Disposal
- Process Water Source
- Water Management Plan
- Reclamation

Farmland proposes to mine their Hardee County, Florida phosphate deposit using two large "walking" draglines (Figure 2-1). One will have a bucket capacity of 45 cu yd; the other, 20 cu yd. These draglines will be capable of removing about 40 feet of overburden and phosphate matrix from the site at a rate of about 250 acres a year, eventually resulting in the mining of 4951 acres of the 7810-acre site over a planned 20-year mine life and the recovery of 39 million short tons of phosphate rock. Over this period, about 174 million tons of overburden will also have been handled. In order to accomplish this, the draglines will frequently have to move considerable distances over land between

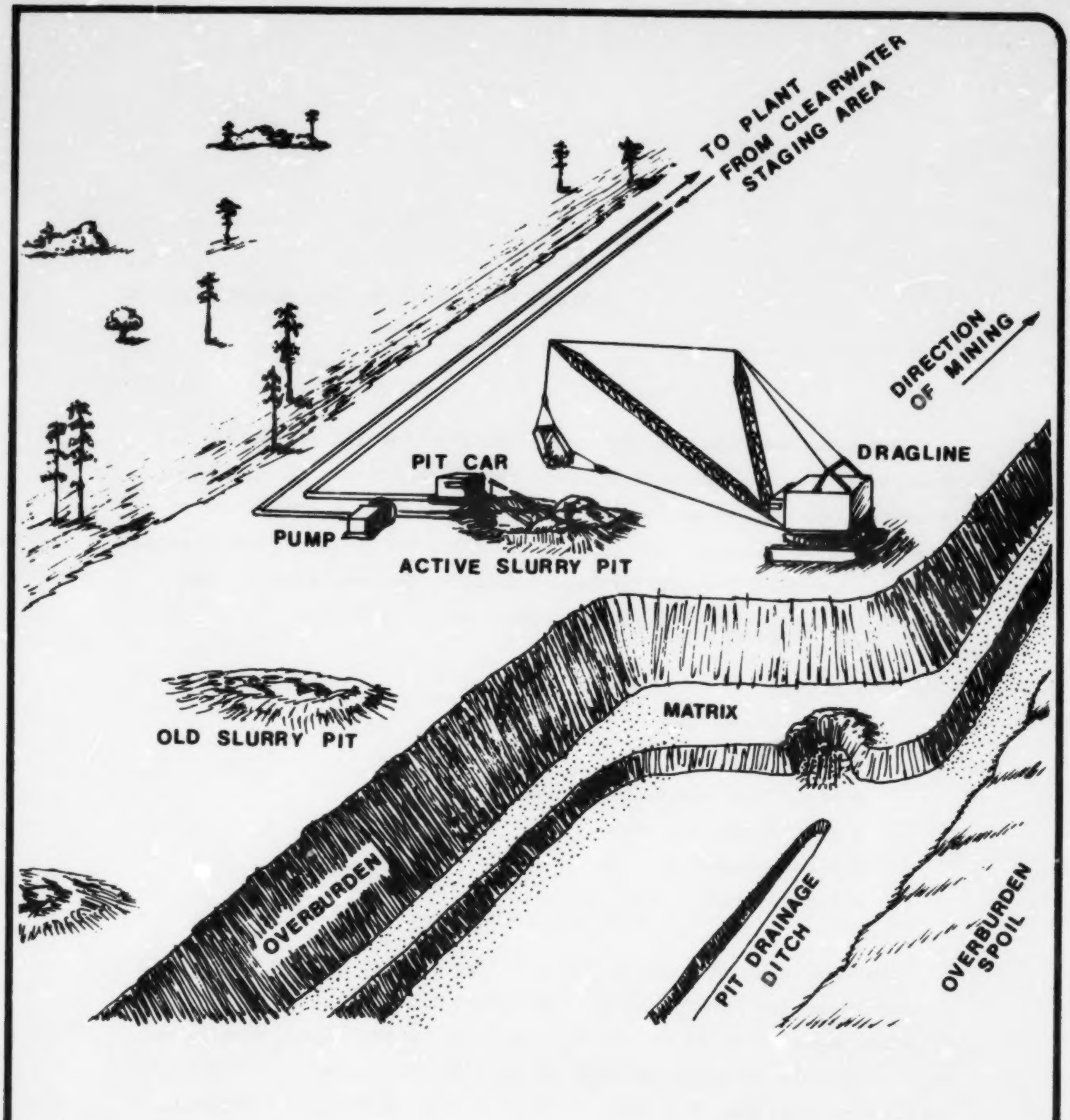
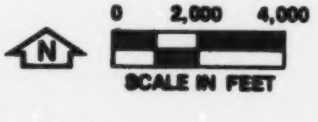


FIGURE 2-1. FARMLAND INDUSTRIES, INC. DRAGLINE MINING AND MATRIX SLURRY TRANSPORTATION SYSTEM.



SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

sequential mining blocks (Figure 2-2). This will necessitate that creeks on the site be crossed on several occasions, and that a travel corridor through otherwise undisturbed land (i.e., Oak Creek Islands) be maintained.

Farmland's proposed mine plan (Figure 2-2) has been developed through the use of a computer model which utilizes the results of prospect drilling and mining and processing equipment specifications to determine the optimum mining schedule. A primary objective of the plan is to achieve both a uniform production rate and product quality from an ore body which is considered to be highly variable. Also part of Farmland's mine plan is the preservation of substantial areas of the site (Figure 2-3). These areas, amounting to about 2530 acres, include the extensive floodplain forest along the Peace River and the mixed forest/wetland area within the Oak Creek drainage basin known as Oak Creek Islands. Also preserved are smaller forested areas along portions of Hickory Creek, Troublesome Creek, and a northern tributary to Oak Creek.

After excavation, the matrix (about 1500 short tons per hour) will be slurried with water (about 18,000 gallons per minuts [gpm]) and pumped via a pipeline to the beneficiation plant (Figure 2-4). The matrix slurry will travel through the pipe at a density of about 26 percent solids, at a rate of about 19,400 gpm. The route of the pipeline to the plant will change as the mining operation does, requiring that several streams be crossed during the life of the mine. Double-walled pipe and catchment basins will be used at such locations (Figure 2-5).

At the beneficiation plant, matrix will be first routed to the washer (an inclined elevated structure) where water will be used with a system of screens and attritioning devices to break down the ore and to size the components into phosphate pebble, waste clays, and feed (sand-sized particles). The screen-separated pebble, if acceptable in quality,

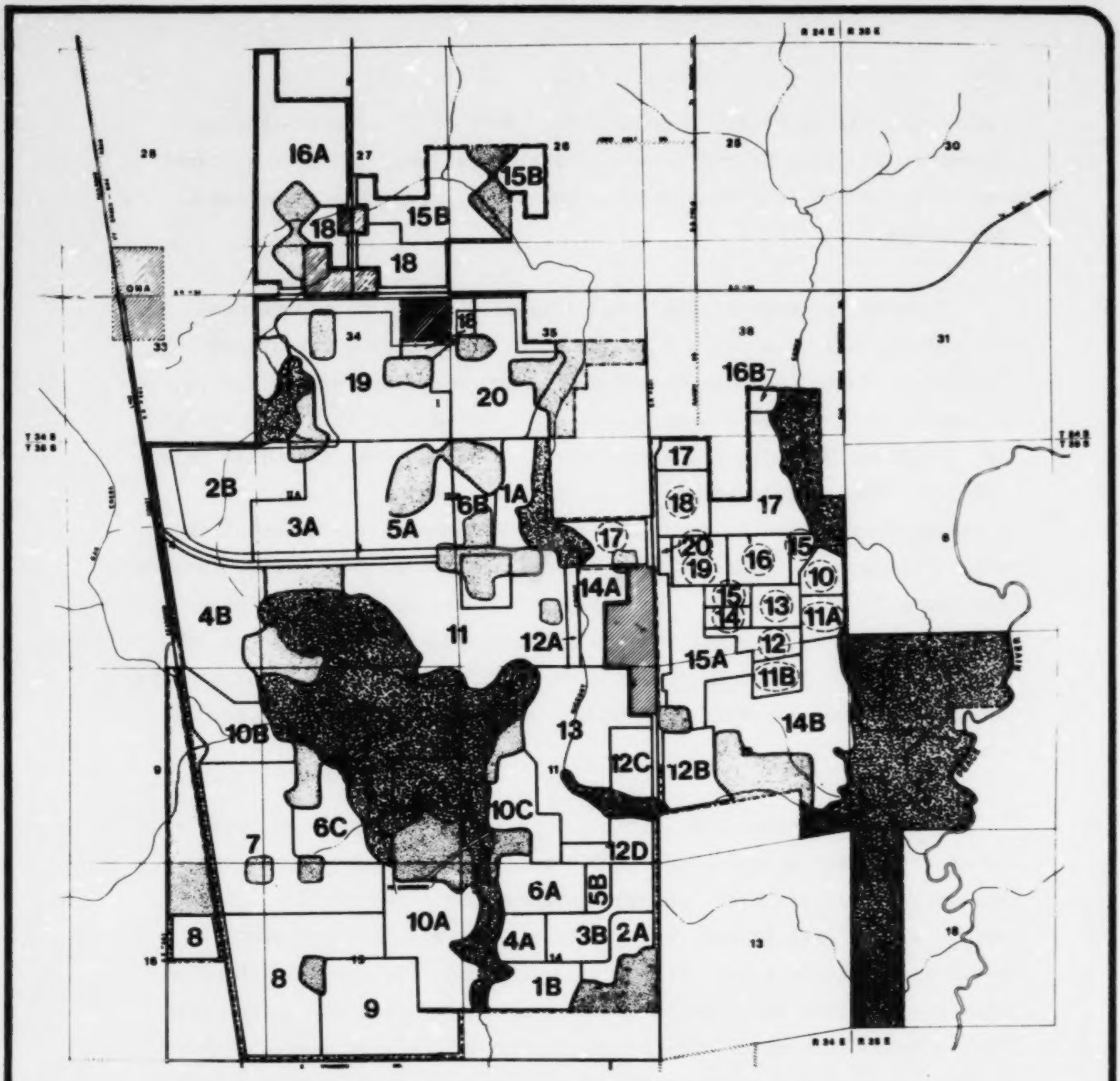


FIGURE 2-2. FARMLAND INDUSTRIES, INC. DRAGLINE MINING SEQUENCE FOR 20-YEAR MINING PLAN.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

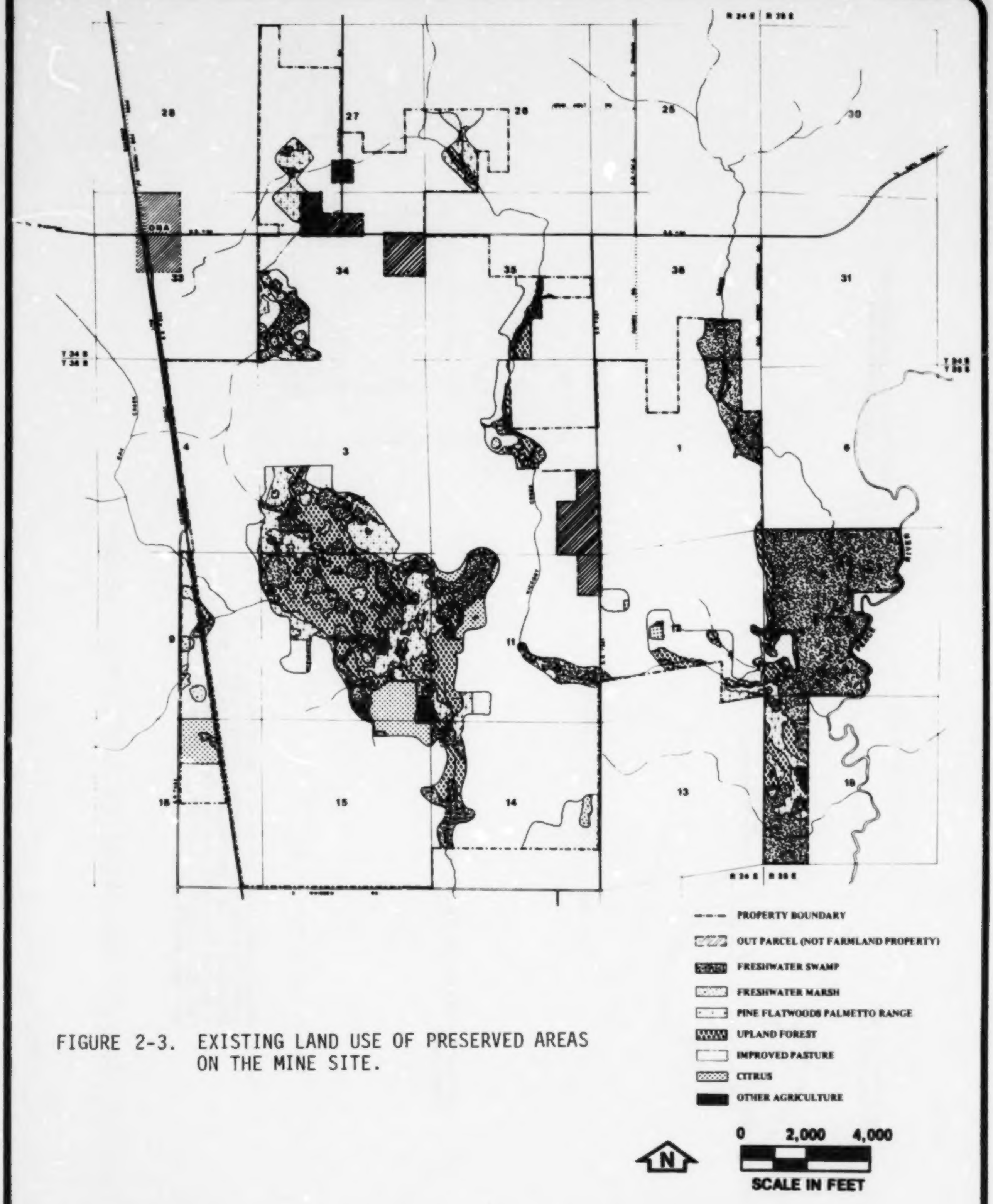
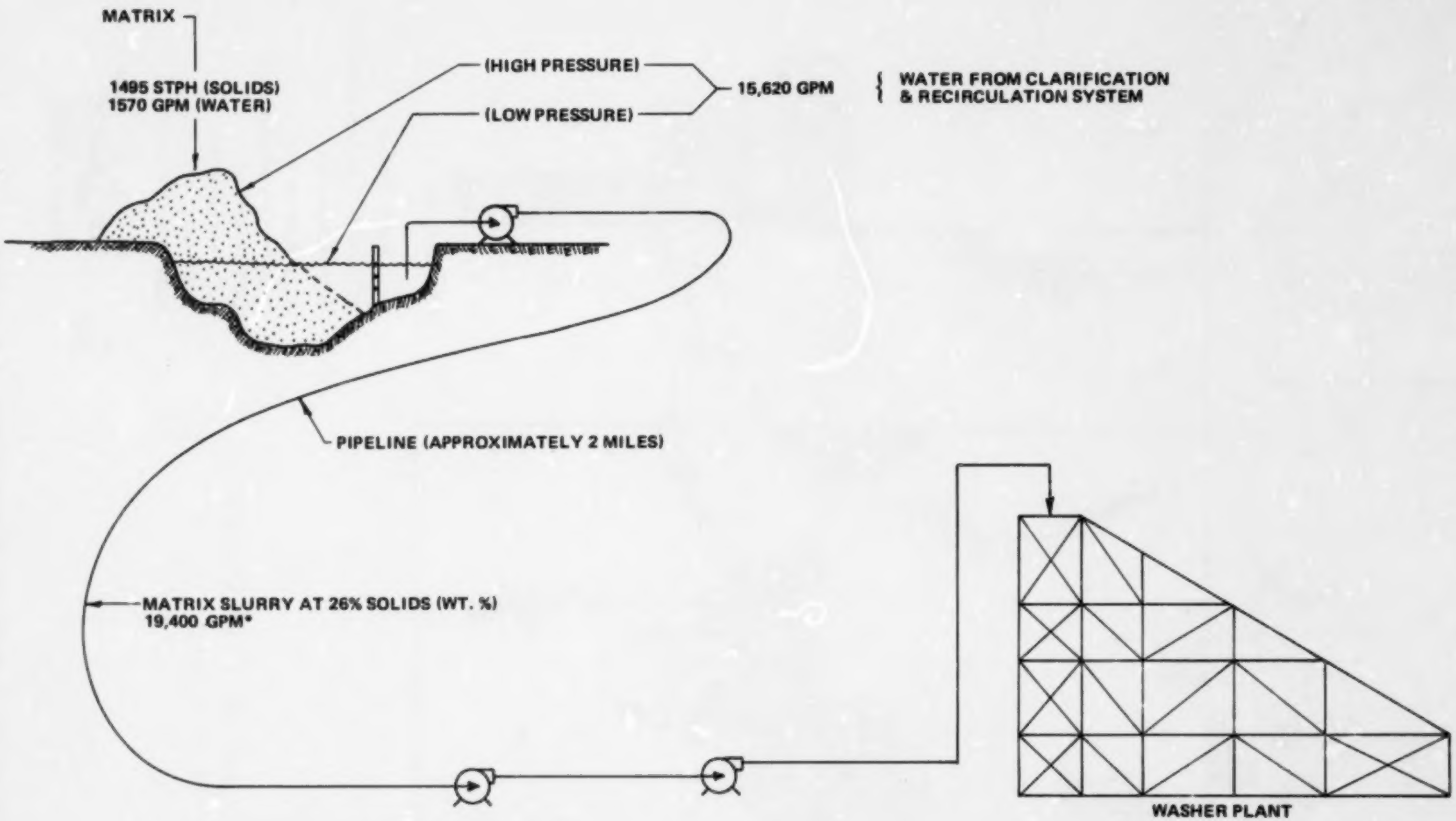


FIGURE 2-3. EXISTING LAND USE OF PRESERVED AREAS ON THE MINE SITE.

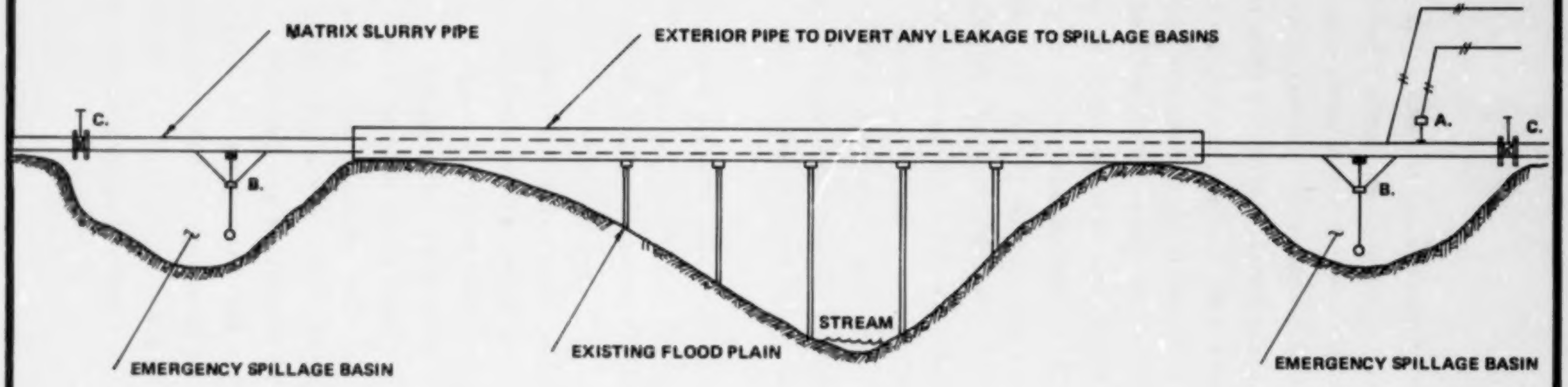
SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979


MATRIX
1495 STPH (SOLIDS)
1570 GPM (WATER)
(HIGH PRESSURE)
(LOW PRESSURE)
15,620 GPM
WATER FROM CLARIFICATION & RECIRCULATION SYSTEM
PIPELINE (APPROXIMATELY 2 MILES)
MATRIX SLURRY AT 26% SOLIDS (WT. %)
19,400 GPM*
WASHER PLANT

*NOTE: APPROXIMATELY 85 GPM OF SEAL WATER WILL ALSO BE ADDED TO EACH PUMP WHICH WILL GENERALLY BE ADDITIVE TO THE ABOVE FLOW. THIS WATER WILL COME FROM THE HIGH PRESSURE WATER LINE, FROM ADJACENT RECIRCULATION WATER CANALS, OR FROM SHALLOW SURFACE WATER WELLS

FIGURE 2-4. SCHEMATIC FLOW DIAGRAM FOR SLURRIED MATRIX TRANSPORT.

SOURCE: J.J. CAPE, 1979.



A. PRESSURE SENSING DEVICE TO SIGNAL IF LEAKAGE DEVELOPS

B. LEVEL SENSING DEVICES TO SIGNAL THAT SLURRY IS FLOWING INTO SPILLAGE BASINS

C. SHUTOFF VALVES TO SEGREGATE MAIN LINE FROM STREAM CROSSING SECTION AS REQUIRED

FIGURE 2-5. TYPICAL MATRIX PIPELINE CROSSING OF STREAM CHANNEL.

SOURCE: J.J. CAPE, 1979.

will be sent to product storage. The waste clays will be removed by hydrocyclones, concentrated by mechanical thickeners, and pumped to the clay settling areas or to mined-out cuts for sand-clay mix waste disposal. The feed areas will be treated with reagents and subjected to a series of flotation steps to separate the phosphatic particles from the silica sand waste (tailings). The reagents used in this process include fatty acid, fuel oil, sodium hydroxide, sulfuric acid, amine, and kerosene. The flotation will be accomplished by two steps. In the first step, or rough flotation, fatty acids and fuel oil will be added to the matrix. The underflow from this step will be transported to the sand tailings disposal area or to the mined-out cuts for sand-clay mix waste disposal, and the overflow will be cleansed. The second step, or amine flotation, will remove additional sand waste and route it to disposal. The phosphatic particles, or "concentrate" product, will then be dewatered and transferred to an outdoor storage area (along with the screen-separated pebble) to await shipment. Drainage from the storage area will be collected and returned to the plant process water flow.

As indicated above, the beneficiation plant will produce both waste sand and clay. For each ton of product, 1.08 tons (dry) of clay and 2.82 tons (dry) of sand will be produced. In terms of volume, these amounts represent 0.004 acre-feet of clay at 17 percent solids and 0.001 acre-feet of sand at about 80 percent solids. The primary methods of waste disposal proposed for the mine will be sand-clay mix deposited in mined cuts (Figure 2-6). However, in the initial years the waste disposal plan requires impoundment of the waste clays in separate settling areas, with a portion of the waste sand to be used as dike building material and backfill. The initial clay settling area (Area I--495 acres) will provide for waste disposal prior to the availability of mined-out areas. Although the ore characteristics are favorable to sand-clay disposal, Farmland has determined that subsequent settling ponds (IIA and IIB--583 acres) will also be necessary to maintain the sand-clay mix disposal areas near existing grade. The method by which Farmland will implement sand-clay mixing as a waste disposal technique

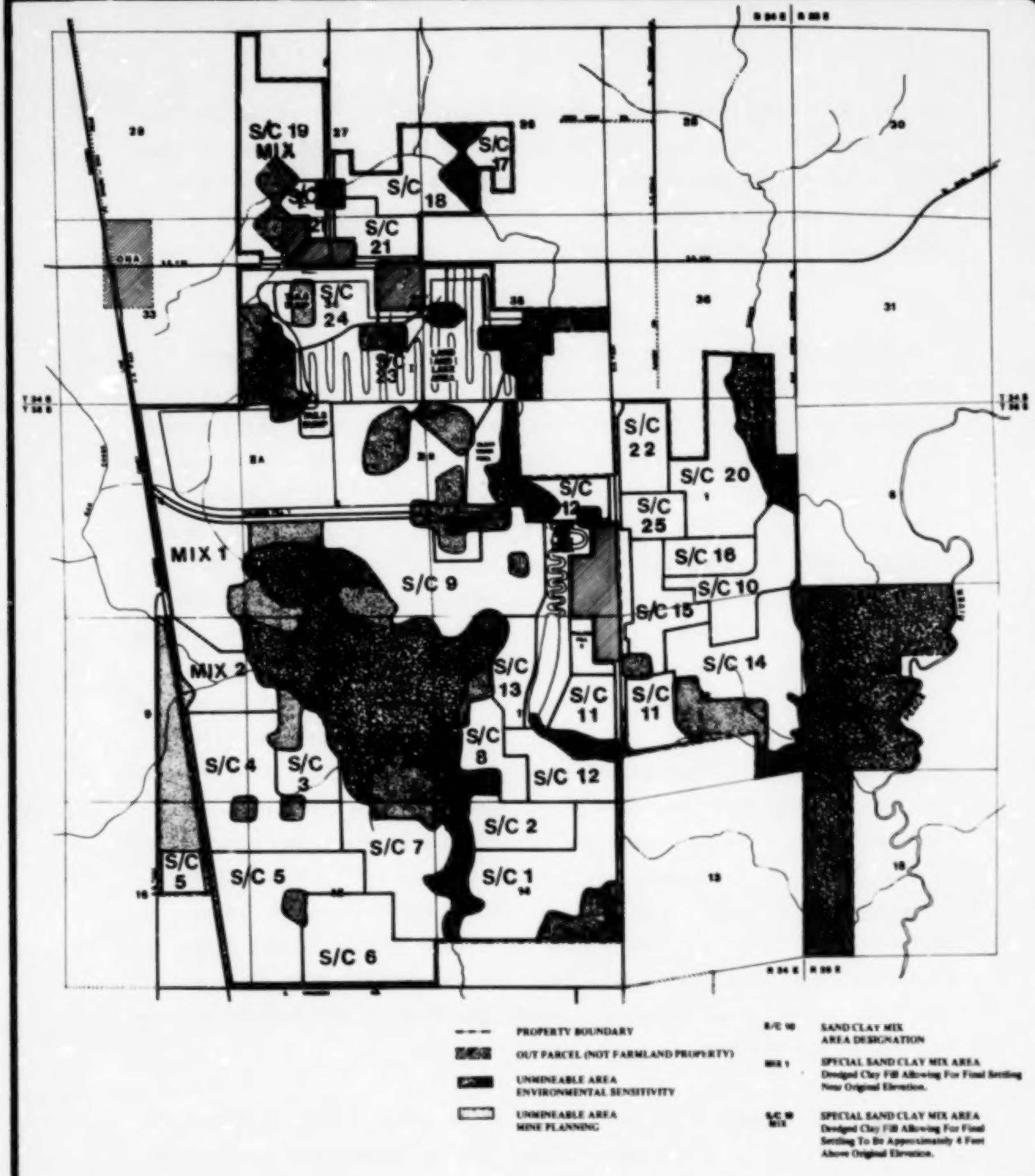


FIGURE 2-6. FARMLAND INDUSTRIES, INC. WASTE SAND AND CLAY DISPOSAL MAP.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

has not yet been established. An acceptable method of mixing the two waste components will continue to be studied by Farmland prior to start-up and then tested operationally. Farmland's intent is to implement full scale sand-clay mixing at the earliest date feasible. A total of 3915 acres of the mined site are scheduled for filling with sand-clay mix.

Water requirements for the Farmland project will be met from groundwater withdrawals and surface water catchment within the recirculating water systems. Farmland's surface water catchment facilities (e.g., from rainfall and seepage) include only those structures that are part of the mining, waste disposal, and water clarification and recirculation system (Figure 2-7), thus the major source of fresh water will be from deep (1400 ft) wells into the Floridan Aquifer (Figure 2-8). The withdrawal from these wells should be about 8.83 mgd under annual average conditions. Most (6.03 mgd) of this will be used in the amine flotation process, which requires high quality water. The remaining 2.80 mgd withdrawn will be required as make-up for losses which occur through entrainment, seepage, evaporation, and shipment (Figure 2-9). The actual process water flow will be much higher (about 72 mgd) than the pumping rate, but most (about 90 percent) of this will be recycled water. During normal operations, the losses which occur in the system will equal the inputs so that a discharge will not be required (Figure 2-9). However, when heavy rainfalls occur (e.g., in June-September) the recirculating system may become overloaded and force a discharge to adjacent surface waters. During periods when the system is receiving above normal rainfall inputs, groundwater withdrawals will be reduced to the minimum required for processing.

When a discharge from the recirculating water system is required, the primary point of discharge will be from the clearwater pond at the beneficiation plant to Hickory Creek (Figures 2-10 and 2-11). A secondary discharge point will also be provided to release clarified water from clay settling area II to Oak Creek. Farmland has requested a

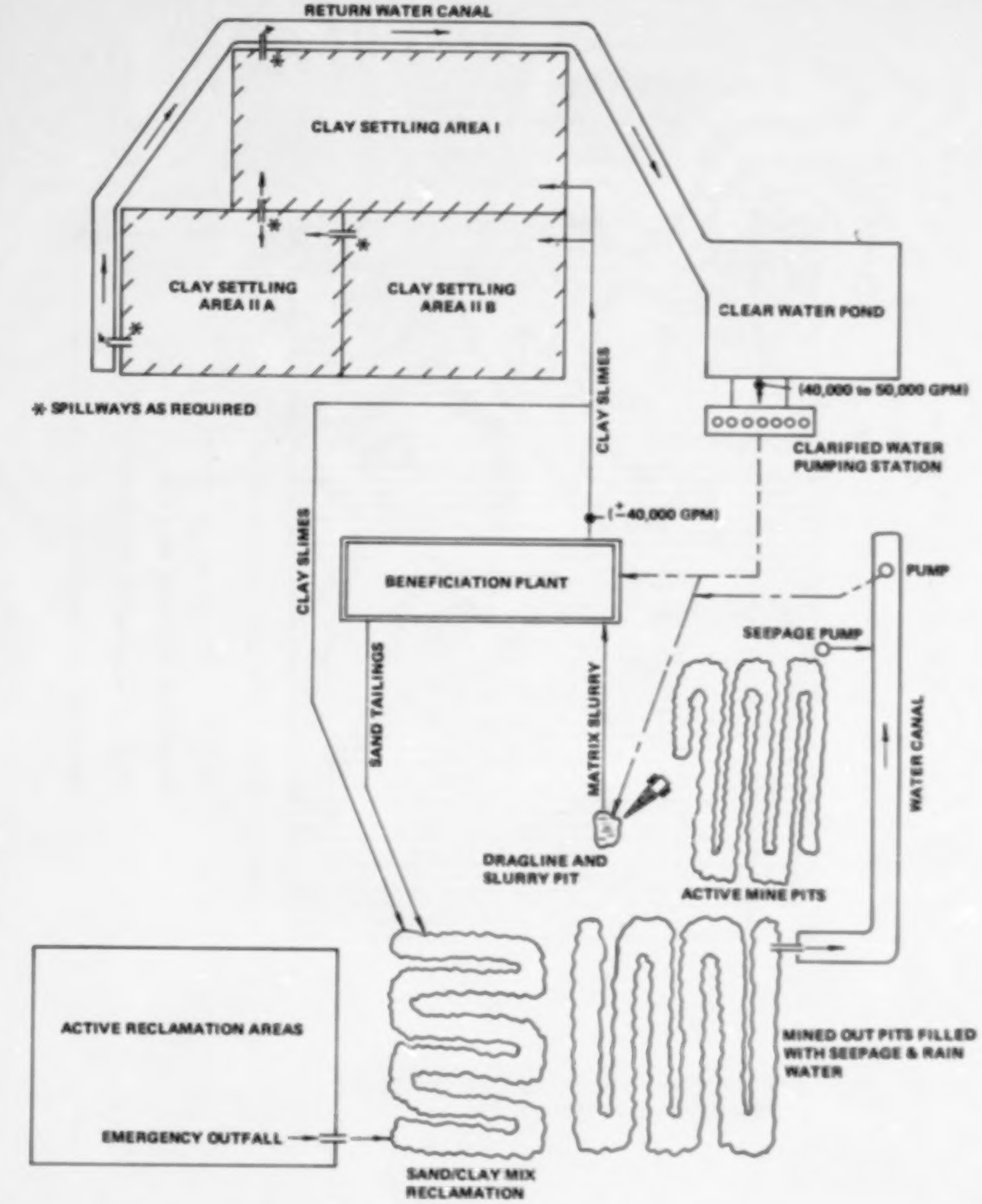


FIGURE 2-7. FARMLAND INDUSTRIES, INC. MINING-WASTE DISPOSAL RECIRCULATION SYSTEM.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

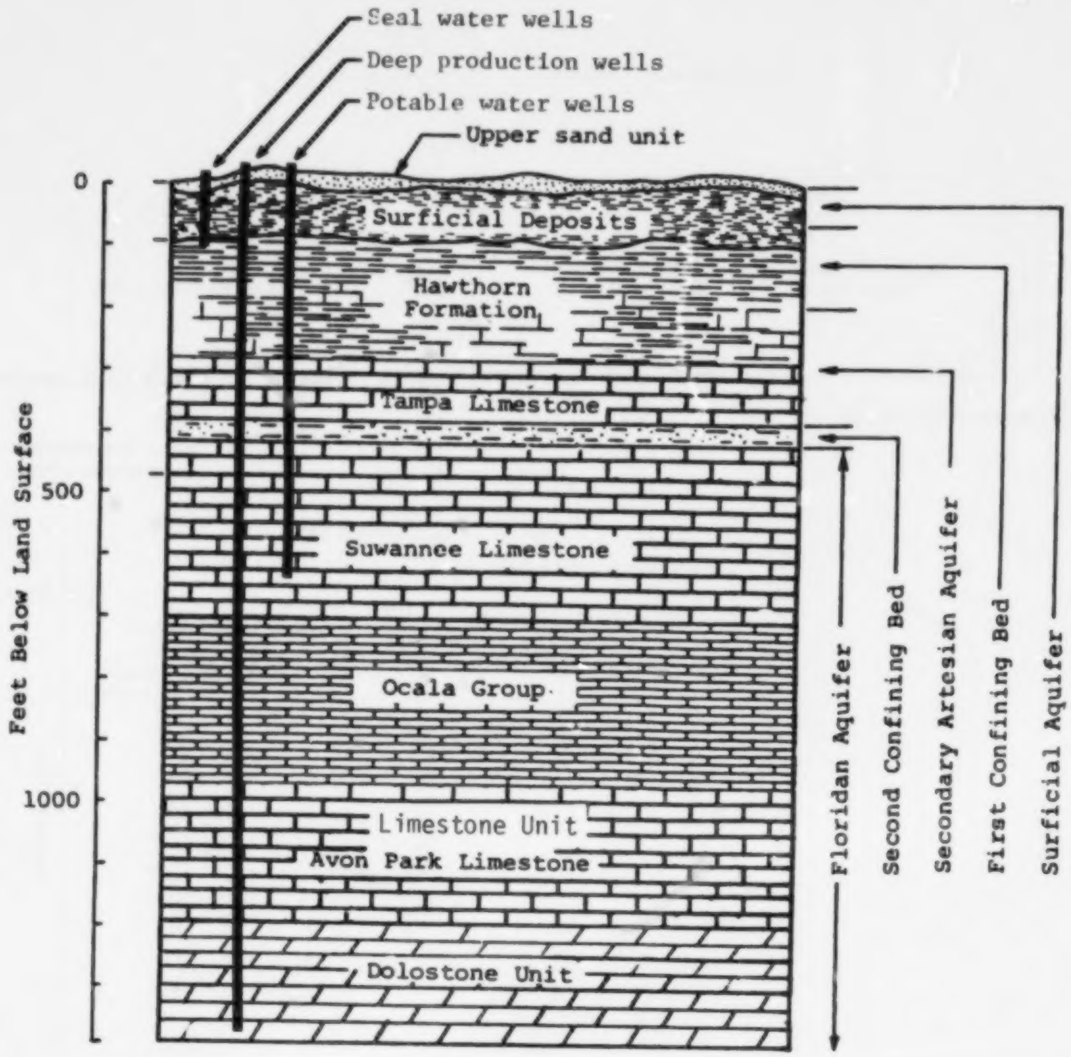
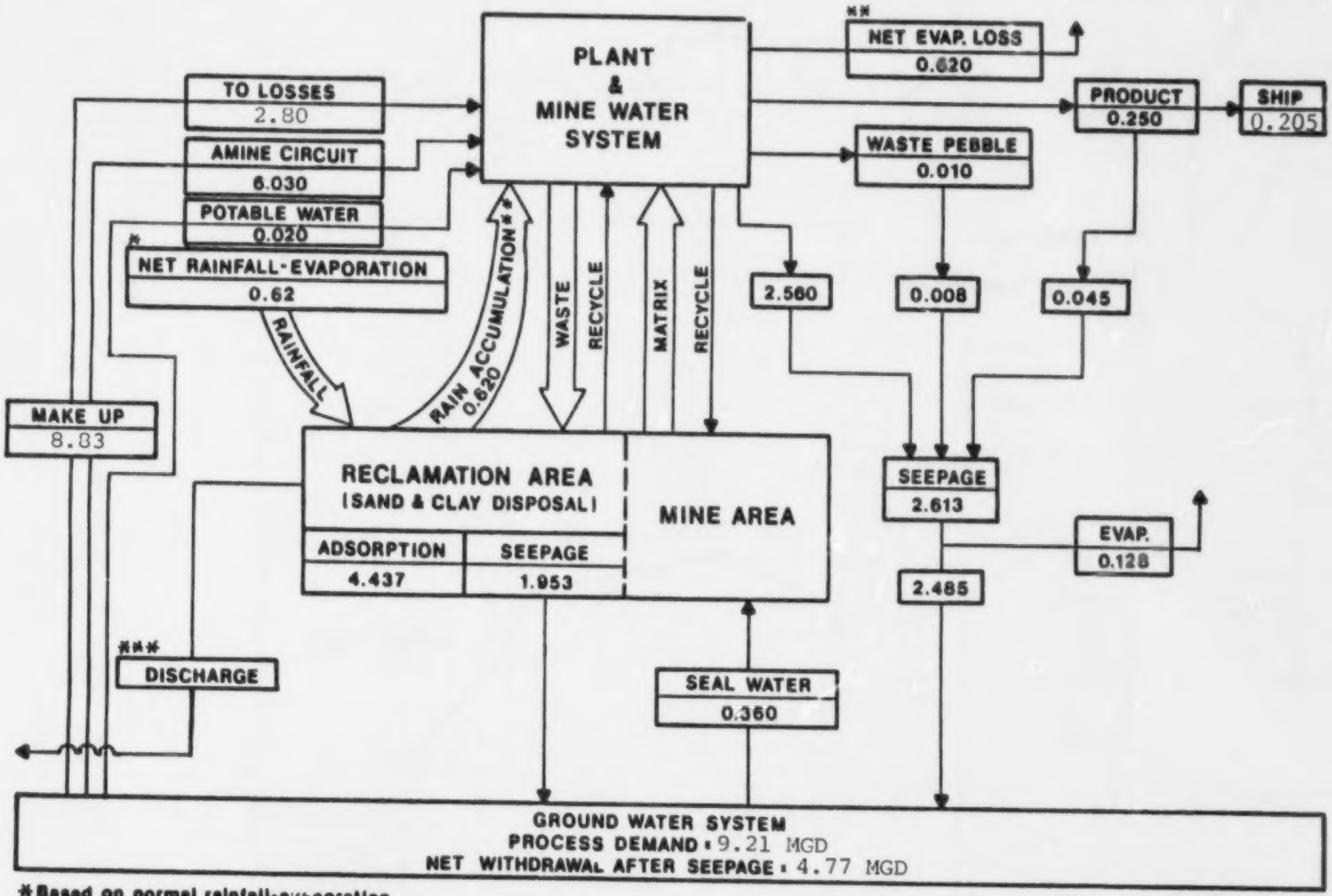


FIGURE 2-8. WELL LOCATIONS WITHIN THE FARMLAND SITE; HYDROGEOLOGICAL CROSS-SECTION.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979



*Based on normal rainfall-evaporation.
**Accumulation offsets mine water system evaporation loss.
***Excess accumulation is discharged as catchment area increases in later years.

FIGURE 2-9. MINE WATER BALANCE DURING THE INITIAL YEARS OF MINING.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

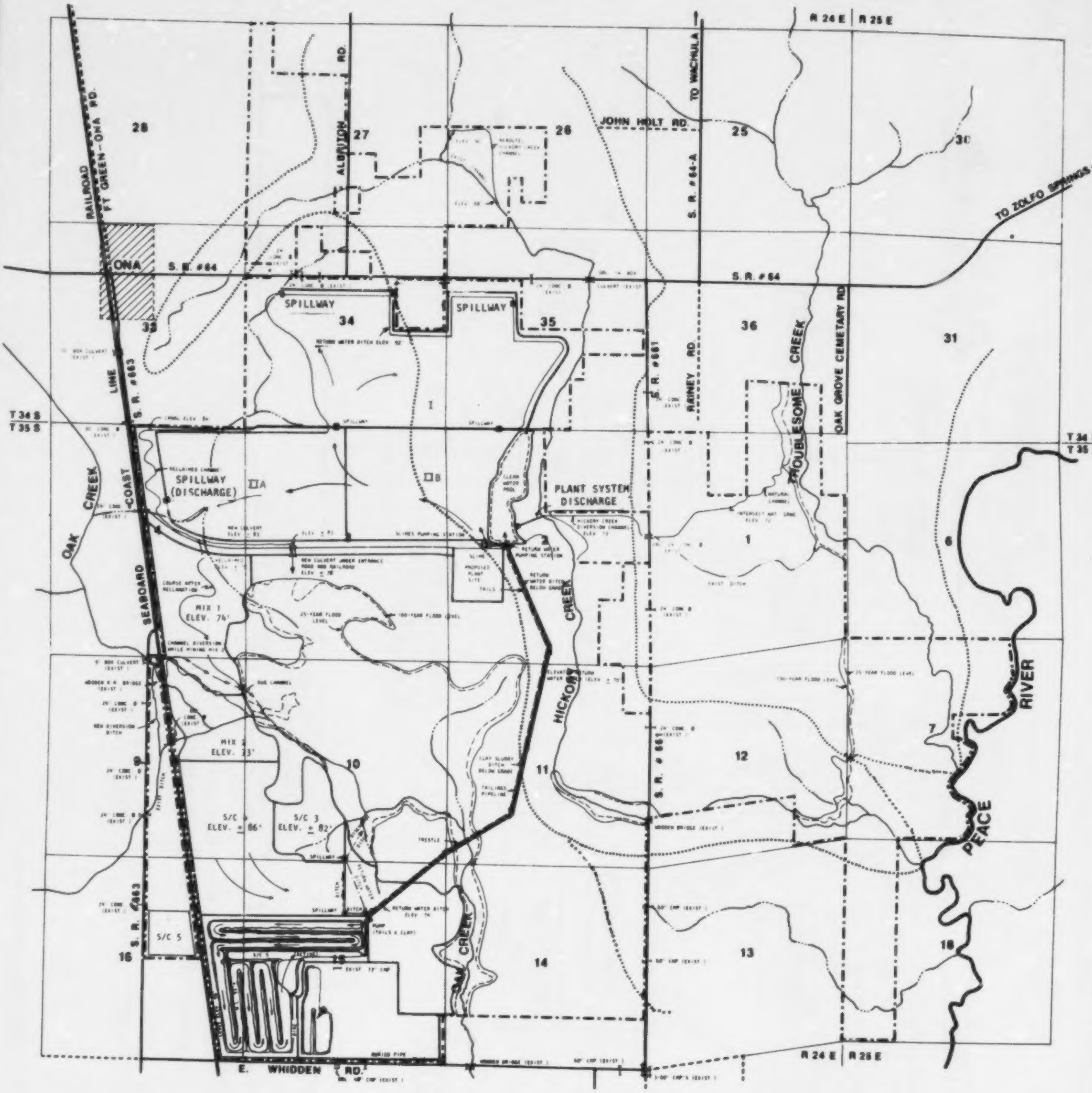


FIGURE 2-10. MASTER DRAINAGE PLAN FOR THE FARMLAND INDUSTRIES, INC. MINE SITE.

.... EXISTING WATERSHED DIVIDE

0 2,000 4,000

SCALE IN FEET

N

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

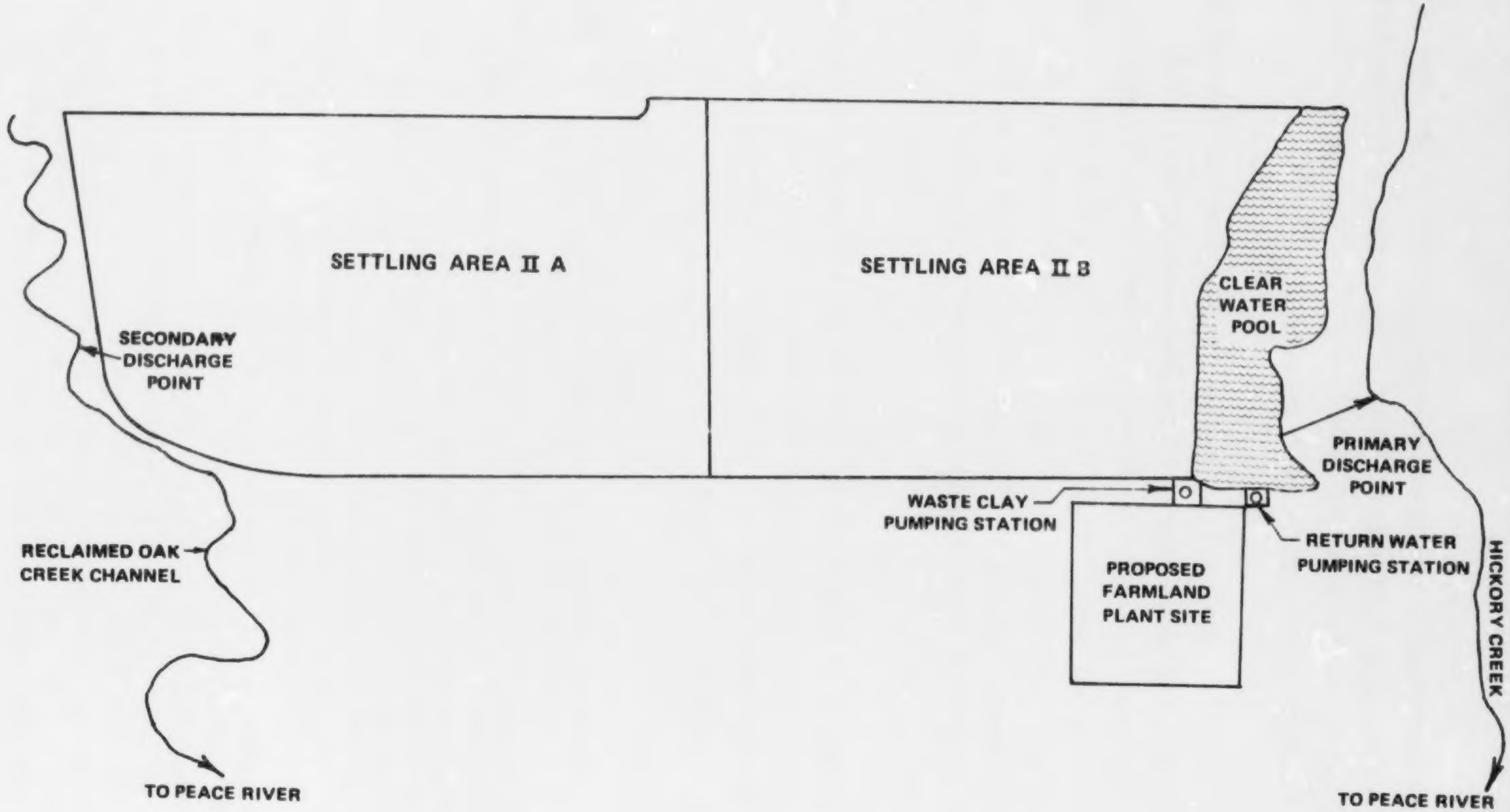

SETTLING AREA II A
SETTLING AREA II B
CLEAR WATER POOL
SECONDARY DISCHARGE POINT
PRIMARY DISCHARGE POINT
WASTE CLAY PUMPING STATION
RETURN WATER PUMPING STATION
PROPOSED FARMLAND PLANT SITE
RECLAIMED OAK CREEK CHANNEL
HICKORY CREEK
TO PEACE RIVER
TO PEACE RIVER

FIGURE 2-11. FARMLAND INDUSTRIES, INC. PRIMARY AND SECONDARY EFFLUENT DISCHARGE POINTS.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

permit to discharge at an annual average rate of 3.75 mgd when rainfall conditions require it (Farmland 1981). The largest discharge anticipated would be on the order of 48 mgd--the discharge of catchment from a 12 in. rainfall over a period of 5 days.

Farmland has developed a detailed reclamation plan for the mined site based on the waste disposal plan presented in Figure 2-6. This plan is designed to return the mined site back to useful acreage, both for human use and for wildlife (Figure 2-12). A comparison of existing land use with post-reclamation land use is provided in Figure 2-13. The post-reclamation topography of the mined site is shown in Figure 2-14. Additional details of this plan are provided in Section 2.7 of this statement.

Farmland's proposed action also includes a number of measures designed to reduce the potential for adverse impacts on the environment. These are described below by the components with which they are most closely associated:

Mining

- The existing vegetative cover will be maintained on all land for which mining or support activities are not imminent.
- The vegetative cover on about one-third of the mine site will be preserved--including the most important wetland acreages.
- Dragline crossings of stream channels will be selected to disturb the least total area, particularly the least wetland area; and crossings of Oak Creek and Hickory Creek will be timed to coincide with the dry, no-flow periods.
- The Oak Creek crossings through the preserved portion of Oak Creek Islands will be made along a single corridor.
- Vegetation will be established on the approaches to creek crossings and these will be maintained until the final crossing is made.
- Fill introduced into creek channels during dragline crossings will be removed after the crossings and the banks immediately stabilized with vegetation.
- Mine cuts adjacent to property boundaries will be promptly backfilled, and rim ditches will be used, where necessary, to maintain Surficial Aquifer levels at adjacent property boundaries.

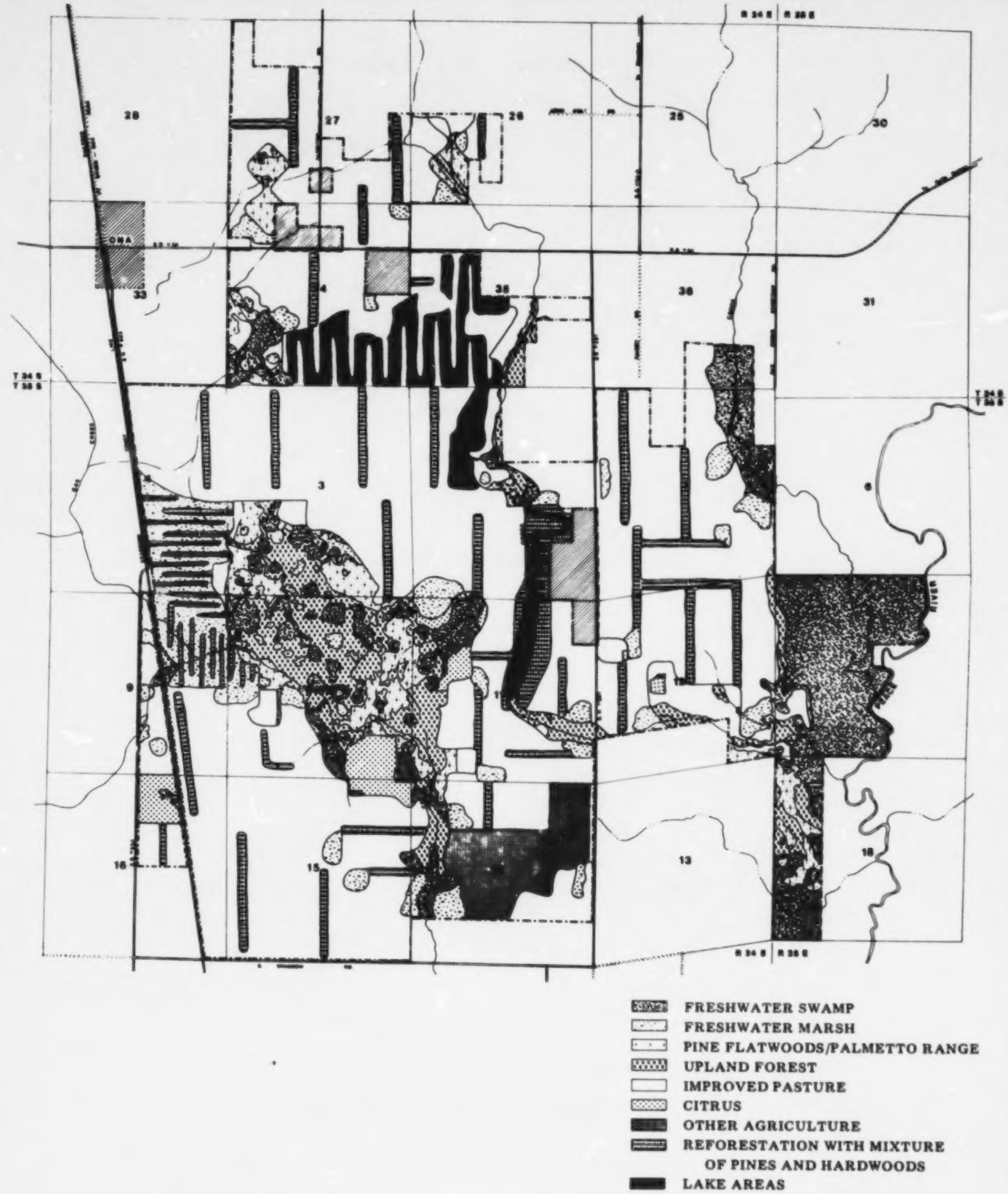
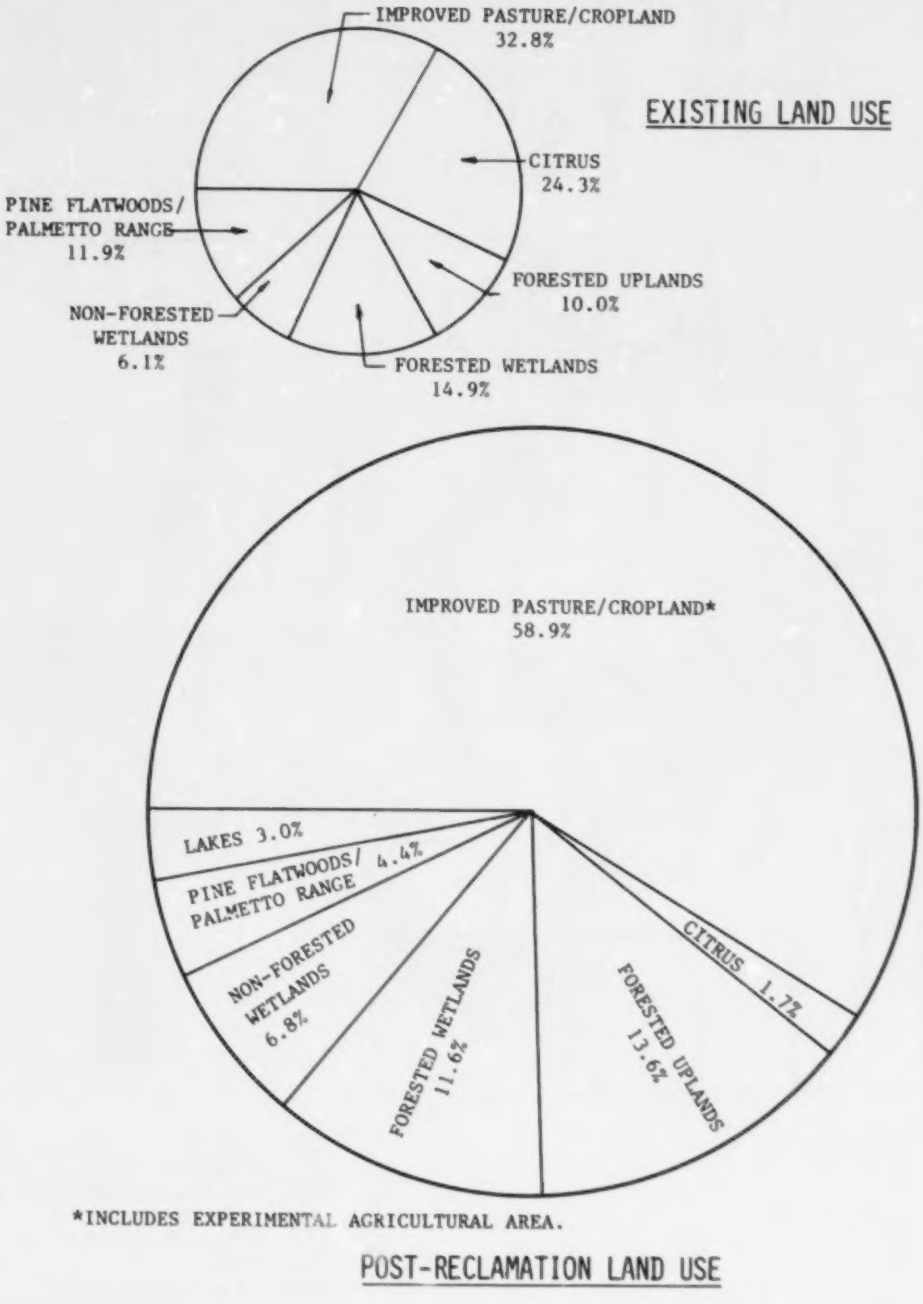


FIGURE 2-12. POST RECLAMATION LAND USE ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979



EXISTING LAND USE

*INCLUDES EXPERIMENTAL AGRICULTURAL AREA.

POST-RECLAMATION LAND USE

FIGURE 2-13. EXISTING AND POST-RECLAMATION LAND USE ON THE MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

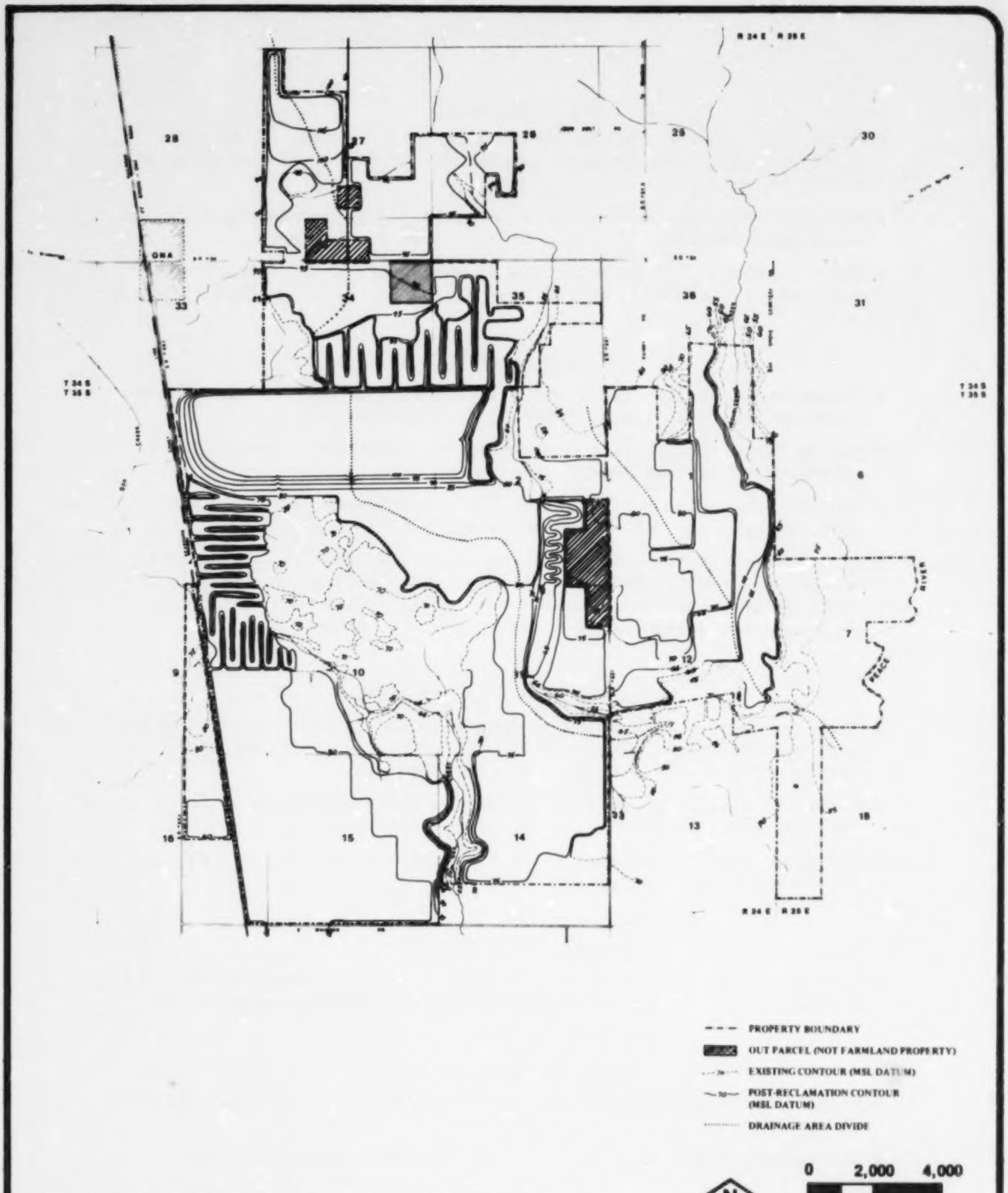


FIGURE 2-14. POST RECLAMATION TOPOGRAPHY ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1978

Matrix Transport

- Double-walled pipe and catchment basins will be used at matrix pipeline stream crossings to contain matrix slurry in the event of a leak at that point.
- Pressure sensitive devices will be installed in matrix pipelines to alert mine personnel to a significant leak in the system.
- Cut-off valves will be installed at both sides of pipeline stream crossings to assist in controlling a pipeline leak at these points.

Matrix Processing

- During plant construction, water sprays will be applied to unpaved areas and roads to reduce particulate emissions.
- During plant construction and operation, perimeter ditches will be installed to collect runoff from the plant site area.
- Storage facilities for reagents, fuel, lubricants, etc. will be above ground within a walled or diked tank farm.
- Petroleum storage tanks will be built to standards and designed to prevent accidental spillage. Storage areas will be designed to route spillage and/or accumulated rainfall to the mine water recirculating system or to a tank within the area.

Waste Sand and Clay Disposal

- The design and construction of dams required for the impoundment of clay and sand-clay wastes will comply with all provisions of Chapter 17-9 of the Florida Administrative Code.
- Dam faces will be planted in grasses to inhibit wind and water erosion, and will be mowed as necessary for visual inspection.
- All dams will be inspected daily by a trained Farmland employee, and annually by a design engineer.

Process Water Source

- Pumping may be reduced in dry periods in order to comply with Southwest Florida Water Management District (SWFWMD) regulations.

Water Management Plan

- Water will be recycled to the maximum extent possible (approximately 90 percent).
- Discharges should occur only during periods of heavy rainfall.

Reclamation

- All dikes and ditches will be graded to acceptable slopes and revegetated.
- All disturbed land will be revegetated. An experimental revegetation program will be conducted on the first sand-clay mix landfill that becomes available to determine the agricultural and wetland restoration potential of such areas.

As stated in the first paragraph of this section, Farmland's proposed action is comprised of a number of project components linked so as to provide a total project capable of meeting Farmland's goals. However, the methods proposed by Farmland to achieve these goals are not the only ones available. In the following sections various methods (alternatives) associated with the previously identified project components are described and evaluated, and the environmentally preferable alternatives are identified. The evaluation is arranged by component in the order previously identified (see page 2-1). The first alternative discussed under a given component heading is Farmland's proposed action, followed by other reasonable alternatives. Also provided in this section is a listing of mitigating measures not included in Farmland's proposed action which would serve to reduce the adverse environmental impact of the project.

2.1 MINING

There are three mining methods currently in use within the industry. These are dragline, dredge, and bucketwheel mining. Any mining operation performed on the Farmland site will include land clearing and open burning, drainage basin alterations, disruption of surface soils and geologic strata over 4951 acres of the mine site, and finally matrix extraction. Associated with these activities will be emissions of particulates and some fuel combustion products, increased surface runoff and erosion, disruption of streamflows and of the Surficial Aquifer, and loss of vegetation, some wildlife, and most wildlife habitats over the same area. It should be recognized that these impacts will occur regardless of the mining method employed. There are, however, specific characteristics associated with each alternative mining method which offer environmental advantages and disadvantages when compared to one another. A general description of each mining alternative is presented below, followed by environmental considerations. Where additional information is required to complete the evaluation, technical and economic considerations are provided. Lastly, a summary comparison is presented to identify the environmentally preferable alternative.

2.1.1 DRAGLINE MINING (FARMLAND'S PROPOSED ACTION)

2.1.1.1 General Description

Farmland proposes to use a single large (45-cu yd) dragline to move overburden and mine matrix during the first 9 years of operation (Figure 2-1). In year 10 a second smaller (20-cu yd) dragline would be added to supplement the larger unit. Other than the fact that Farmland proposes to initially mine with a single large dragline (rather than two smaller units), the proposed mining method is as conventionally practiced in the Florida phosphate industry.

Farmland's proposed mining sequence (Figure 2-2) has been developed through the use of a computer model which simulates the mining and processing of the entire mineable deposit on an annual basis over a period of 20 years using the results of prospect drilling on the site and the preliminary design of the mining and processing equipment as input data. Each mining block illustrated in Figure 2-2 is designated by year and relative position within the year (e.g., Block 6B would be mined in year 6, after Block 6A and before Block 6C). Land clearing and site preparation activities will precede the mining of each block. It is estimated that about 250 acres would be mined each year of operation, but that the amount of cleared land in front of the active mining pit would be about 20 acres.

In order to permit draglines to move between sequential mining blocks in years 4, 6, and 10, a corridor will be established through the lower portion of Oak Creek Islands (Figure 2-15) an area to be largely

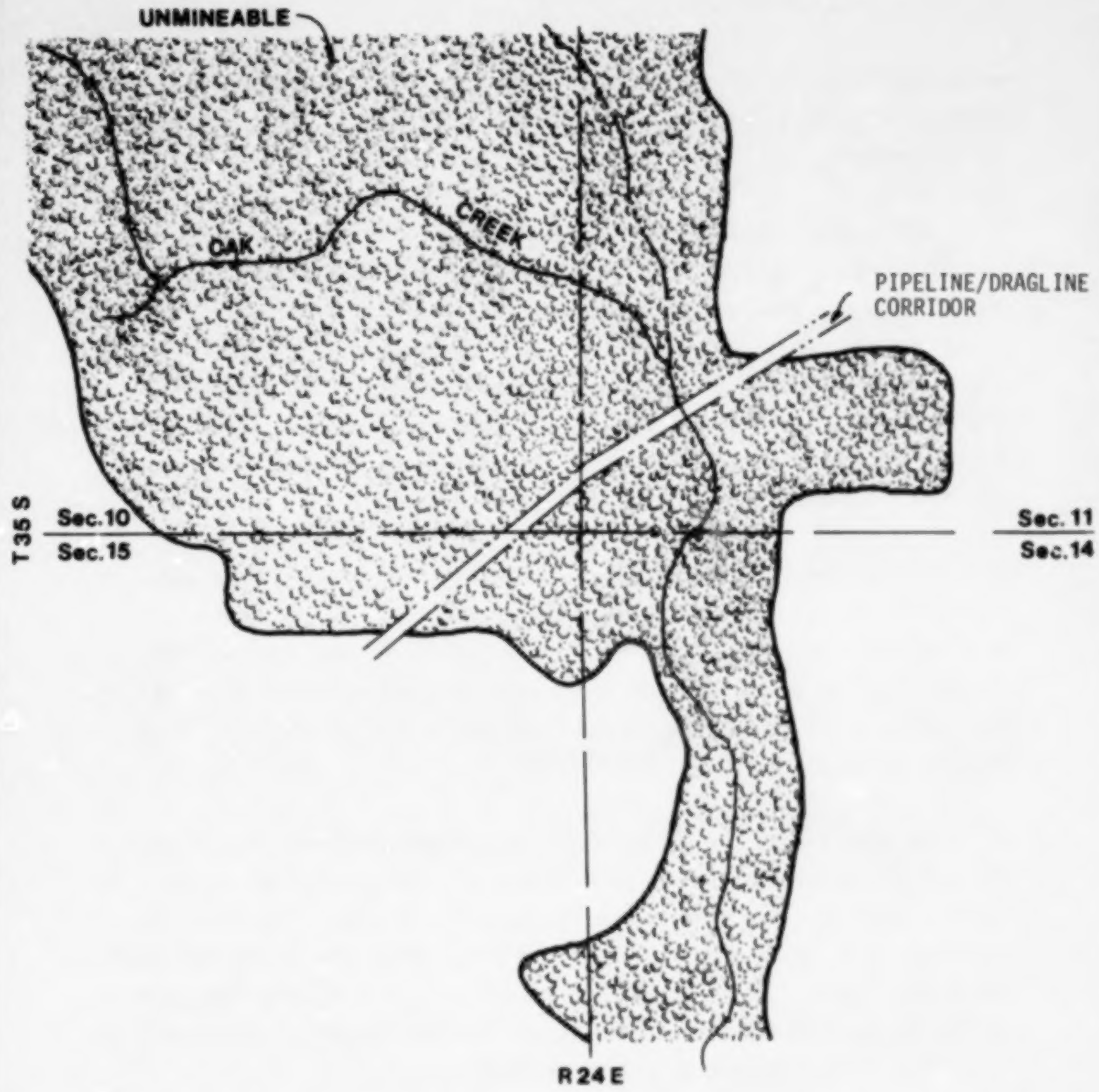


FIGURE 2-15. LOCATION OF THE PROPOSED PIPELINE/DRAGLINE CORRIDOR THROUGH THE PRESERVED PORTION OF OAK CREEK ISLANDS ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

preserved by Farmland's proposed mine plan. Matrix pumping and waste disposal pipelines and a mine access road will also be routed through this corridor.

Once existing vegetation has been cleared from the approaches to the crossing, grasses will be established to prevent erosion and turbid runoff into the creek. The approaches will be maintained until the final crossing has been made in year 10. Farmland will attempt to time the dragline crossing to coincide with no-flow periods in the creek so that diversion of the creek will not be necessary. Once a crossing has been made, any fill introduced into the channel will be excavated and the banks immediately stabilized with vegetation.

In addition to the three planned dragline crossings of the preserved portion of Oak Creek, the mining plans call for the mining dragline to cross the western portion of Oak Creek, as it moves from mining block 4A to 4B, and the previously diverted northern tributary of Oak Creek, as it moves from mining block 4B to 5A. The natural stream courses in these areas are to be mined.

The mobility of the draglines which Farmland proposes to utilize for the mining of their phosphate deposit is a key factor which was incorporated into the development of their mining plan. This mobility will also allow Farmland to mine around areas which are to be preserved under their plan. These areas (shown in Figure 2-3) account for 2530 acres, or approximately one-third of the mine property. This acreage is comprised of the following land use acreages:

Land Use	Preserved Acreage
Improved Pasture	456
Citrus	160
Other Agriculture	58
Pine Flatwoods/Palmetto Range	354
Coniferous Upland Forest	47
Hardwood Upland Forest	187
Mixed Upland Forest	276
Freshwater Marsh	107
Freshwater Swamp	885

As indicated above, 992 acres of wetlands will be preserved under Farmland's mining plan. This acreage amounts to nearly all (98 percent) of the Category 1* Wetlands on the mine site.

2.1.1.2 Environmental Considerations

Environmental Advantages. Using dragline mining, overburden could be handled such that it could be selectively returned to the mined out pit. This would allow the operator to place undesirable material (e.g., leach zone) at the base of an adjoining spoils pile and cover it with other overburden or waste from the beneficiation plant. Secondly, because of the close proximity of the dragline to both the active and mined out areas, handling of overburden could be accomplished in an energy-efficient manner.

Draglines, being relatively mobile and capable of mining along irregular boundaries, provide the capability of mining around areas to be preserved. Other mining methods would likely be more restrictive in this respect.

Environmental Disadvantages. The open pits created by dragline mining would drain water from the adjacent Surficial Aquifer. The amount of drainage would vary, but should average about 500 gpm. This dewatering may have an effect on the water level in adjacent streams (especially Hickory Creek) and the vegetation of adjacent areas (especially wetlands). This effect would be most evident during dry seasons.

Dragline mining would also create a very uneven spoiling pattern, sometimes called windrows. The creation of such windrows will require that heavy equipment be utilized in reclamation to create a more uniform topography. Such leveling will require the burning of fuel (in heavy equipment) and result in increased air pollutant levels (e.g., combustion products).

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*Category 1 Wetlands are those wetlands on the site which occur within the 25-year floodplain of the Peace River or its tributaries upstream to the point of 5 cfs mean annual flow, or wetlands considered to be significant wildlife habitat.

2.1.2 DREDGE MINING

2.1.2.1 General Description

Dredge mining of overburden and matrix is not practiced today in the Florida phosphate industry, but dredges are in current use for the mining of other sedimentary mineral deposits as well as for harbor and canal work. Texasgulf Chemicals Company (in North Carolina) has been dredging the upper 40 ft of their overburden prior to dragline mining. This has been reported to be a successful technique in North Carolina, largely because of the extremely wet upper overburden conditions which had caused serious mine recovery problems when only draglines were used for overburden removal.

The three most common dredge types are the bucket line, cutter head, and bucketwheel. Each is basically a large, barge-mounted machine consisting of a continuous digging apparatus mounted on a long boom extending below the water surface. The bucket line unit consists of a series of chain-carried buckets which continuously transfer material up to the barge. The other two units cut material loose beneath the water surface and pump it to the surface via a suction pipe.

If the Farmland phosphate deposit were to be dredge mined, two units would likely be required. The overburden above the matrix would be dredged by the first unit; the second would dredge the matrix. Initially the overburden would be pumped to a separate impoundment area. Once the mining pit was established, diked disposal areas would be created within the pits. Matrix would be pumped directly from the dredge to the beneficiation plant.

2.1.2.2 Environmental Considerations

Environmental Advantages. Dredge mining would require that the active mining pit (i.e., pond) be flooded to sufficient depth to support a barge-mounted dredge. Thus, the environmental impacts associated with dewatering of the Surficial Aquifer (described under dragline mining) would not occur.

Dredged overburden would be slurry pumped from the active pond to a diked settling area some distance away. Overburden deposited within this area would settle and dewater, the water being returned to the recirculating water system. Overburden deposited in such a manner would tend to produce a flattened surface. Thus, leveling of the ridges produced by dragline mining (and the associated fuel consumption/combustion emissions) would not be required.

Environmental Disadvantages. Maintaining sufficient water within the active mine area to support a barge-mounted dredge would likely require that water from deep wells or surface waters be added to the pond during the dry season. The amount of water required to maintain the pond depth at a suitable level would depend on factors such as the area being mined as a unit, the evaporation rate, and the rate at which water moved from the pond into the adjacent Surficial Aquifer. In general, groundwater requirements for dredge mining would likely be greater than for dragline mining.

As indicated above, dredged overburden would be slurry pumped to diked disposal areas to dewater. Such disposal areas would likely be diked to sufficient height to receive the slurried overburden as well as waste materials from the beneficiation plant, so that the volume of material stored above ground would be higher than for matrix processing waste disposal alone. The added volume would be occupied in part by entrained water, the amount depending on its clay content. If significant amounts of clay were present in the overburden, the entrainment of water could result in at least a short-term water loss to the system.

Dredge mining would not provide the opportunity to selectively place undesirable material (e.g., leach zone) within overburden disposal areas. Material handling using dredges would also require more energy than draglines and would not be as efficient at resource recovery. The dredge operator would not be able to view the matrix-overburden interface; therefore some matrix would likely be removed in the overburden dredging operation and lost within the disposal areas.

2.1.2.3 Technical Considerations

If the character of the overburden and matrix of the Farmland deposit is compared only with material handline capabilities of a dredge, there is no technical reason why the deposit cannot be dredge mined. The material generally is soft and sandy, with occasional hardpan areas. The cutter head type dredge may have difficulty, but either the bucketwheel or bucket line dredge could mine the Farmland property quite comfortably. Very sophisticated and yet practical equipment is available to permit very exact location of the cutting face and avoid dilution with overburden. The depths required per the character of the Farmland deposit are well within the limits of very common dredging equipment.

While dredges are technically capable of handling overburden and matrix on the Farmland site in place of draglines, the following are several reasons why dredge mining of the Farmland deposit is considered technically unfeasible:

- Dredge mining slurry density levels are an unknown in the Florida phosphate industry, and will remain so until a major test is performed.
- It would be impractical for a dredge to contend with the mobility required in the Farmland Mining Plan as illustrated in Figure 2-2. Farmland's phosphate reserves are so highly variable in character that in-plant blending would most likely not permit the optimum single pond, two dredge approach.

Of the above considerations, the most critical is that of dredge slurry density. Mining equipment manufacturers generally quote a unit which will produce a continuous slurry density of 25 percent to 35 percent solids. This is the level which is normally achieved today with draglines and their associated slurry transport system. Purchasing a dredge without the assurance that it could move on the order of 1500 tons per hour at 30 percent solids could lead to serious production problems for Farmland (i.e., the amount of material moved at 15 percent solids would be less than half that moved at 30 percent solids). Without a major and very costly test of a dredge operating within a typical Florida phosphate deposit (which has not been done) a proven slurry density or capacity rating cannot be assumed. The range of tonnage capacities achieved at various slurry densities would be as follows:

Slurry Density (wt. % Solids)	System Slurry Capacity	Tonnage Capacity	% of Required Capacity
35	16,200 gpm	1,820 TPH*	121%
30	16,200 gpm	1,500 TPH	100%
25	16,200 gpm	1,200 TPH	80%
20	16,200 gpm	930 TPH	62%
15	16,200 gpm	670 TPH	45%
10	16,200 gpm	430 TPH	27%

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*Tons Per Hour

Dredge mining would also introduce organic contaminants from the overburden soils into the recirculating water system. This could result in operational difficulties unless water treatment facilities were installed to remove them.

2.1.3 BUCKETWHEEL MINING

2.1.3.1 General Description

Bucketwheel excavators are large continuous mining machines which normally operate in conditions usually much drier than Florida phosphate pits. These units would excavate material with a series of buckets mounted on the periphery rotating wheel and drop it onto a conveyor belt system. Overburden would be routed for disposal in previously mined areas, while matrix would be sent to the beneficiation plant. A modification of this technique will be utilized by North Carolina Phosphate Corporation in the mining of their North Carolina reserves. In this case, bucketwheels will be used only for the removal of upper overburden, with the remainder of the overburden and matrix to be mined with a large dragline. An advantage of this system is that overburden can be selectively placed between the windrows created by the dragline, thus reducing the need for leveling.

If the Farmland phosphate deposit were to be mined with bucketwheels, it would probably be done using two units--one to excavate overburden and a second to excavate matrix. Overburden would be placed directly into the pit by way of a mobile stacker, ending up in spoil piles nearly identical to those which draglines produce. The matrix would be transferred to a belt conveyor and transported to the plant.

2.1.3.2 Environmental Considerations

Environmental Advantages. Like dragline mining, bucketwheel mining would result in the placement of overburden from the active mining area into nearby mined areas. However, this would be accomplished by way of conveyors and stackers which would be capable of distributing the overburden such that the windrows formed by dragline casting could be eliminated. The surface created for further waste disposal would therefore be more level than that created by draglines.

Environmental Disadvantages. Bucketwheels would operate within the open pit, rather than on a natural ground ahead of the mining operation (as draglines do). Thus, it would be necessary to control the amount of water within the pit to a greater degree than with draglines. This would probably require that wells be located in advance of the mining operation and in its immediate vicinity to dewater the Surficial Aquifer. Working in material such as that at the Farmland site, bucketwheels would also be more energy consumptive than draglines.

2.1.3.3 Technical Considerations

It may be impractical to utilize bucketwheels for mining in any of the southern Florida phosphate areas because of the extremely wet conditions which can occur in the pits. Bucketwheels can traverse in wet muddy pits only with great difficulty.

Bucketwheels must also operate with their wheel digging into a near vertical embankment in order to be effective. The wet sandy overburden or matrix embankments on the Farmland property may not always stand in this manner. If caving and sluffing occurred, the result would be a very poor operating factor.

Lastly, the overburden and matrix are often very "sticky". When this were the case, the wheel mechanism and conveyors would not be able to handle the material very effectively. The buckets on the wheel would not empty and the conveyors would not discharge or transfer properly. Because of the need to move 1000 and 2000 tons per hour, an intolerable operating situation could result in a very short time.

2.1.4 SUMMARY COMPARISON - MINING

Overriding advantages offered by dragline mining are maximum operation energy efficiency, relatively decreased water consumption, and opportunity for selective spoil placement. These outweigh the lesser advantages offered by the other two alternatives. Therefore, dragline mining is the environmentally preferable mining component alternative.

2.2 MATRIX TRANSPORT

There are three matrix transport methods which could be used to deliver mined material to the plant for further processing. These are slurry transport, conveyor transport, and truck transport. A general description of each matrix transport alternative is presented below, followed by environmental considerations. Where additional information is required to complete the evaluation, technical and economic considerations are provided. Lastly, a summary comparison is presented to identify the environmentally preferable alternative.

2.2.1 SLURRY MATRIX TRANSPORT (FARMLAND'S PROPOSED ACTION)

2.2.1.1 General Description

Slurry matrix transport (Figures 2-4 and 2-16) is used at most existing Florida phosphate mines. Matrix would be placed into a slurry pit and mixed with recycled water (17,720 gpm) from high pressure nozzles, breaking down the clay and sand matrix into a 26 percent solids matrix slurry which would then be transported through a pipeline (16-20 inches) to the beneficiation plant by a series of large pumps operating at about 19,400 gpm. The turbulence produced by the high pressure nozzles, pumps, and pipeline would all contribute to the processing sequence to follow at the plant.

The pumps used to move the slurry from the active mine pit to the plant would be located in series along the pipeline route at distances such that surges against any one pump will be prevented. The horsepower required to move the matrix solids and transport water is approximately 3400 HP, assuming an average pumping distance of 10,000 ft. The transport water used can be clarified recycle water from most any source. However, water used in the pump seals* must be of high quality and would be obtained from shallow wells into the Surficial Aquifer. This water is used to force solids out of critical wear points.

The pipeline used to transport matrix from the active mine pit to the beneficiation plant will be rerouted as the mining area changes. This will require that streams on the site be crossed and a corridor through an otherwise preserved area be established. The corridor used will be the same as that provided for dragline crossings through the area.

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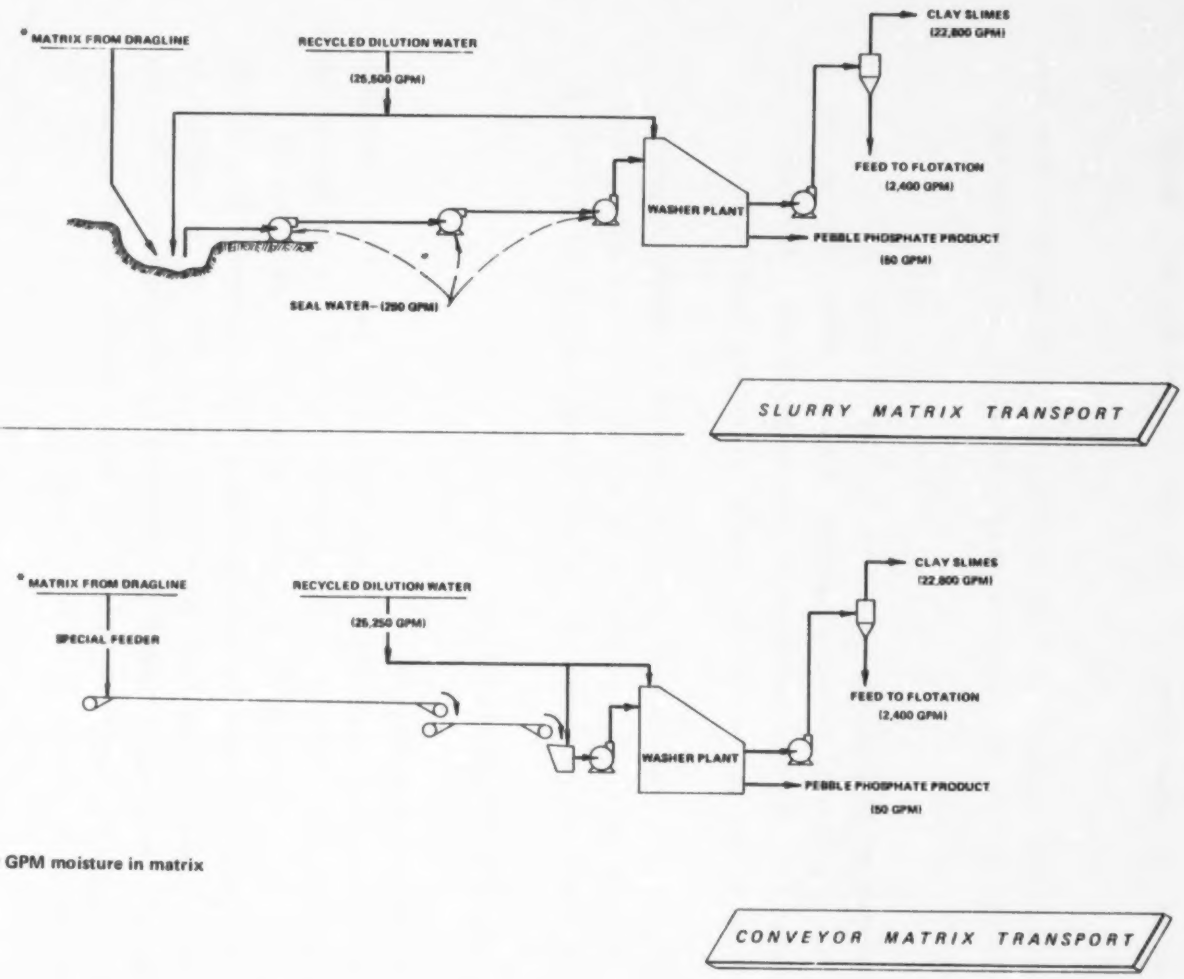
* A pump seal is the closure between the rotating shaft and the pump housing.



*Not considering 1570 GPM moisture in matrix

FIGURE 2-16. SLURRY AND CONVEYOR MATRIX TRANSPORT FLOW DIAGRAMS.

SOURCE: J.J. CAPE, 1979

2.2.1.2 Environmental Considerations

Environmental Advantages. Matrix transported by slurry pipeline would be closed to the atmosphere and, thus, particulate emissions would be nil.

The corridor required for the slurry pipeline would also cause the least disturbance to vegetation and wildlife of all the alternatives considered.

Environmental Disadvantages. A number of streams would be crossed by the slurry pipeline as mining progresses over the site. A potential would exist for pipeline leaks and/or breaks which could increase turbidities in surface waters (especially at stream crossings).

Pumping would also require a relatively large amount of energy (e.g., pumping 1500 tons per hour at 26 percent solids a distance of 10,000 ft would require about 23,800,000 Kwh of electricity per year).

2.2.2 CONVEYOR MATRIX TRANSPORT

2.2.2.1 General Description

Conveyor matrix transport (Figure 2-3) would require that matrix be placed onto a belt conveyor at the mine for transport to the beneficiation plant. In order to minimize the number of transfer points and still maintain mobility of the conveyor sections, such a conveyor belt system would most likely include belt sections of up to 2000 ft in length. As the mine pit advanced, it would be necessary to move or extend the belt system in the same direction--resulting in continuous sections ranging from 10,000 ft to 20,000 ft in total length.

2.2.2.2 Environmental Considerations

Environmental Advantages. Because the matrix would be transported in a relatively dry state, the potential for spillage of matrix into surface waters would be reduced--although spillage prevention/containment measures would still be needed at stream crossings.

Conveyor matrix transport would also require less energy than slurry pumping (e.g., conveyor transport of 1500 tons per hour a distance of 10,000 ft would require 7,000,000 Kwh of electricity per year--less than one-third of the energy required for the pumping of matrix a similar distance).

Environmental Disadvantages. There may be a slight increase in particulate levels near moving conveyors.

2.2.2.3 Technical Considerations

None of the Florida phosphate industries have attempted raw matrix transport with a conveyor. However, new equipment could be developed which would provide a means of controlling feed rate and avoiding matrix stickiness problems--the technical problems associated with this alternative. Brewster Phosphate Company operates a matrix conveyor, but this conveyor carries partially processed matrix (i.e., matrix which is transported by conventional pumping to a set of cyclones which remove some of the oversize material and clay slimes and partially dewater the material before it drops onto the belt). The Brewster system provides no real technical advantage over the present slurry matrix transport systems, but is intended to save on pumping costs.

2.2.3 TRUCK MATRIX TRANSPORT

2.2.3.1 General Description

In evaluating the use of trucks for matrix transport, it is assumed that draglines would be used for excavating the matrix. A dragline would load the trucks, which would then transport the matrix via haul roads to the beneficiation plant. At the plant matrix would be dumped and/or washed out of the trucks and, as with conveyor transport, mixed with recycle water before further processing.

2.2.3.2 Environmental Considerations

Environmental Advantages. The potential for spillage of matrix into surface waters at stream crossings would be the least of all the alternatives considered.

Environmental Disadvantages. The construction and use of haul roads required for truck transport would cause the most disturbance to vegetation and wildlife of all the alternatives considered. Trucks would also require the use of large amounts of fuel, and result in additional air emissions--from fuel combustion, fugitive dust, and the matrix itself.

2.2.4 SUMMARY COMPARISON - MATRIX TRANSPORT

Disadvantages of truck transport far outweigh any advantages. It should be noted that while both trucks and the conveyor method avoid the use of large amounts of recycle water to transport matrix, this is not a real advantage in that an equivalent amount of recycle water would be added to the matrix on arrival at the plant before further processing. Because conveyor matrix transport lessens the potential for spillage at stream crossings and because it would require significantly less energy than slurry pumping, it represents the environmentally preferable alternative. However, at the present time difficult technical problems appear to preclude its feasibility.

2.3 MATRIX PROCESSING

Matrix processing takes place in what is generally called a beneficiation plant. The location of such a plant on the Farmland site will result in the alteration of surface soils and construction of roadways, railways, and various structures. The area required for such plant facilities should be similar, regardless of which matrix processing method is used.

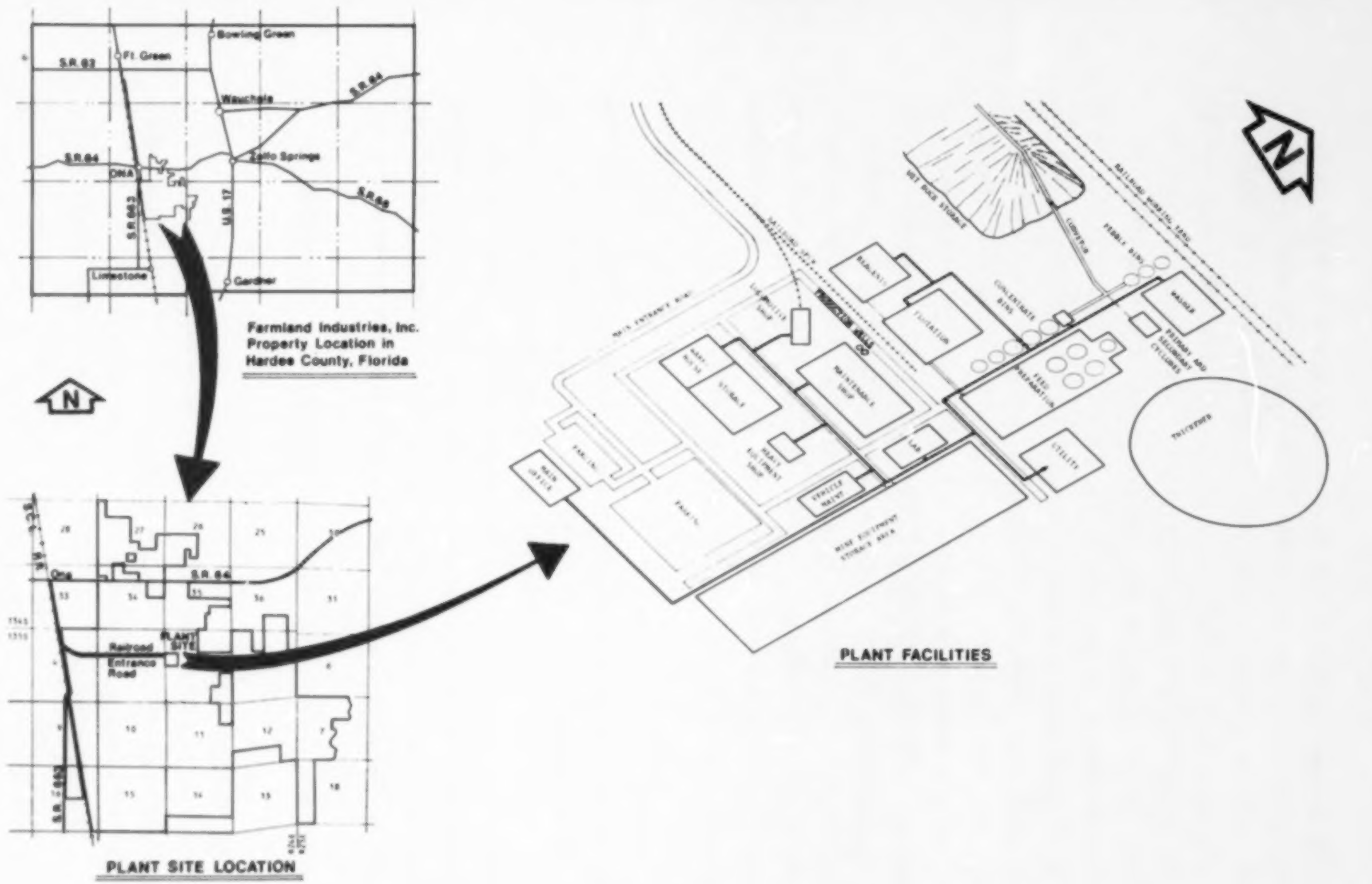
Farmland has proposed that the plant facilities be located on an unmined area of about 111 acres (Figure 2-17). From the engineering standpoint, it is desirable that the site be located such that matrix transport distances will be minimized and valuable phosphate will not be covered with relatively permanent structures. Also a consideration in the location of such a plant is the habitat value of the existing vegetation which occurs on the area to be disturbed (Figure 2-18). From Figure 2-18 it is evident that the plant site location proposed by Farmland is also environmentally preferable, for it occurs within what is currently improved pasture. The access corridor (from the existing SR 663 and Seaboard Coast Line Railroad) is also located along an environmentally preferable alignment, through what is mostly pasture and pine flatwoods-palmetto range. Only relatively minor amounts of more valuable habitats (e.g., hardwood upland forest and freshwater marsh) will be affected by this alignment. The location of these facilities on other centrally located portions of the site which are not to be mined would result in greater losses of habitat than Farmland's proposed location.

There are two matrix processing methods currently in use within the industry. These are conventional matrix processing and dry matrix processing. A general description of each matrix processing alternative is presented below, followed by environmental considerations. Where additional information is required to complete the evaluation, technical and economic considerations are provided. Lastly, a summary comparison is presented to identify the environmentally preferable alternative.

2.3.1 CONVENTIONAL MATRIX PROCESSING (FARMLAND'S PROPOSED ACTION)

2.3.1.1 General Description

Conventional matrix processing involves the separation of phosphate rock from waste sand and clay using a series of wet-process operations. These consist of washing, feed preparation, and flotation. In the washer area (Figure 2-19) the oversize waste material and pebble product would be removed. The remaining material (finer than 1 mm) would be



Farmland Industries, Inc. Property Location in Hardee County, Florida

PLANT SITE LOCATION

PLANT FACILITIES

FIGURE 2-17. LOCATION OF BENEFICIATION PLANT FACILITIES ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

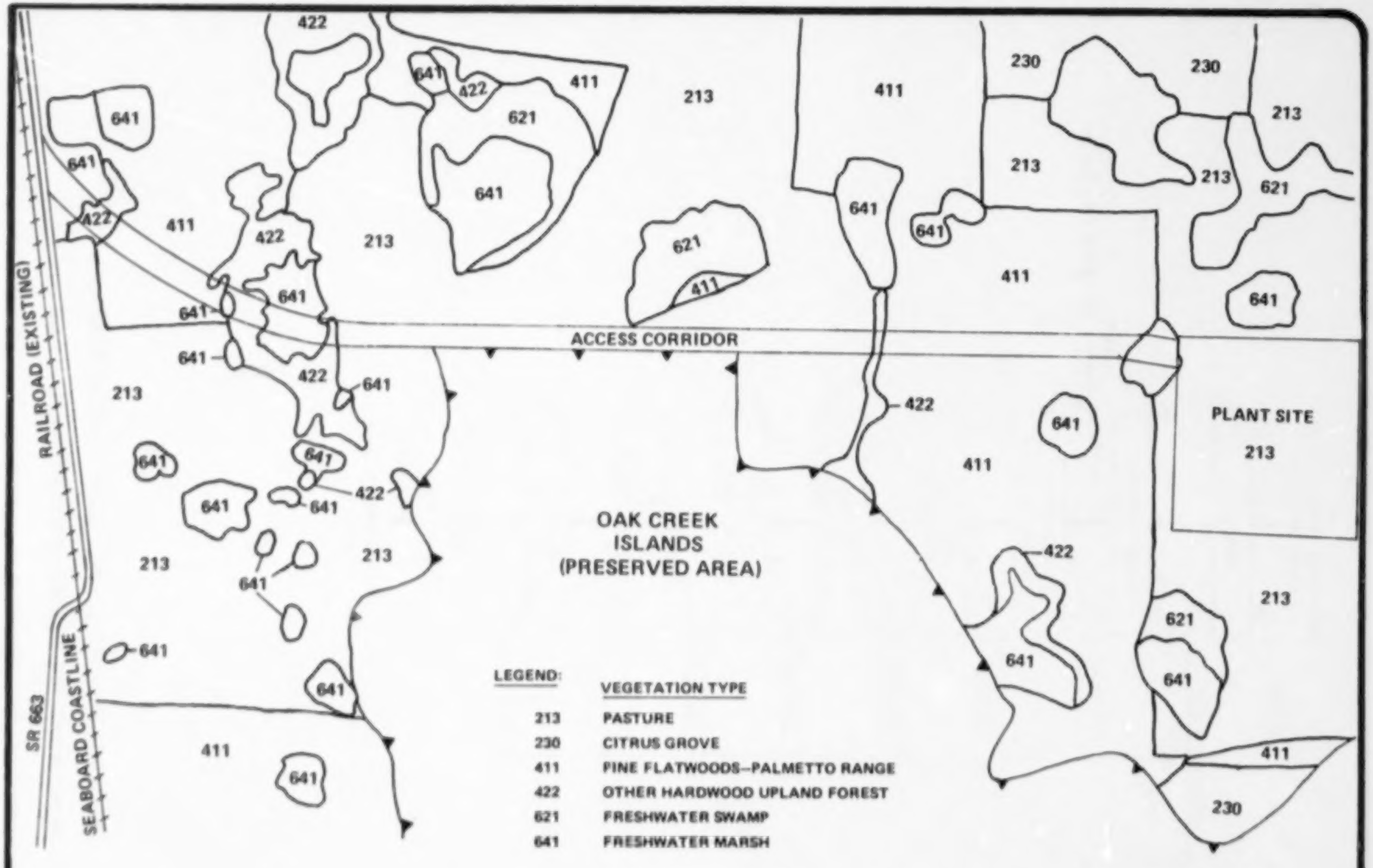


FIGURE 2-18. VEGETATION TYPES IN THE VICINITY OF THE PROPOSED FARMLAND INDUSTRIES, INC. PLANT SITE.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

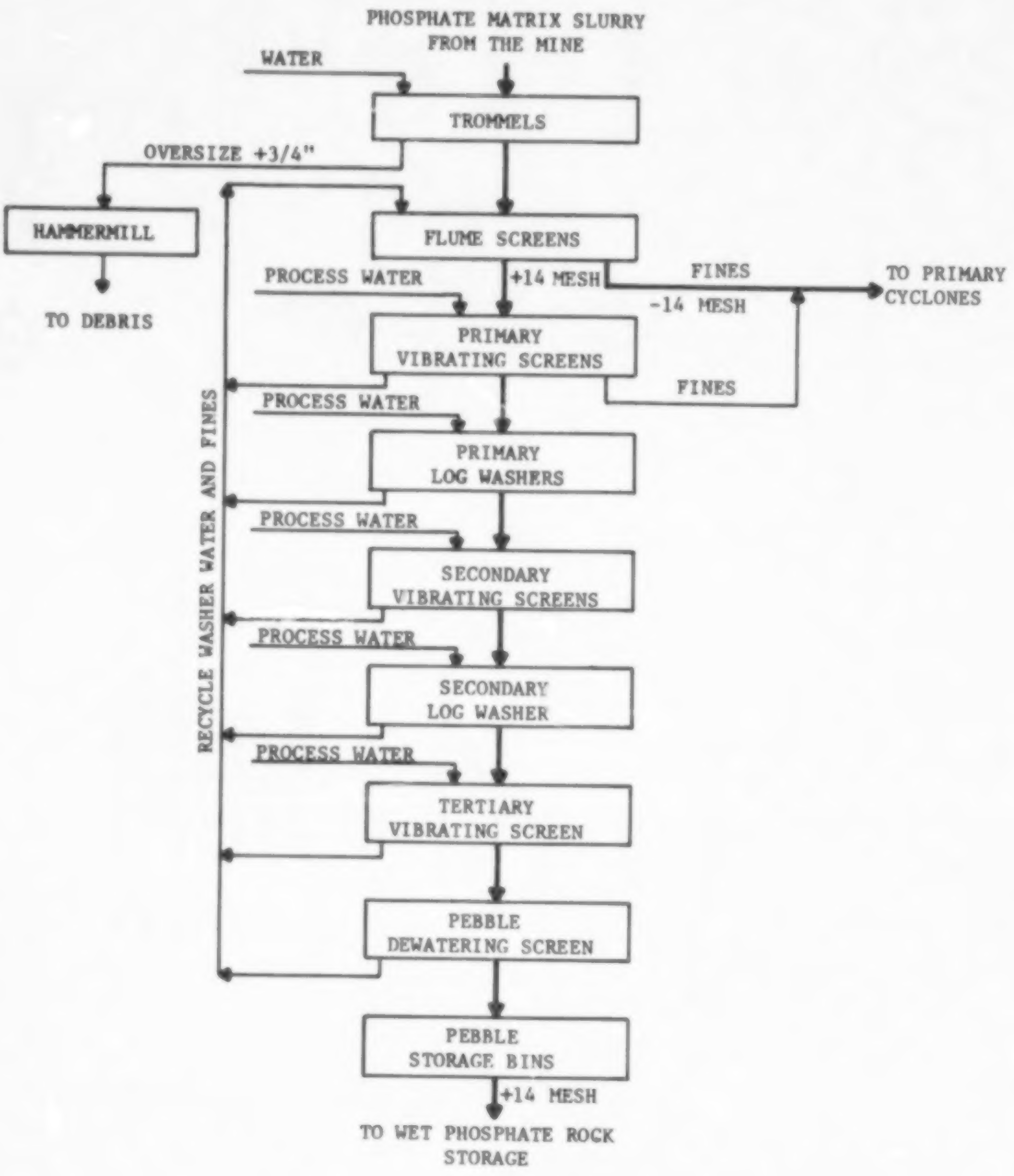


FIGURE 2-19. FARMLAND INDUSTRIES, INC. WASHER PROCESS FLOWSHEET.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

routed to the feed preparation area where hydrocyclones would separate the very fine material (minus 0.1 mm), which is mostly clay, from the sand size material. Although these clays contain phosphate, there is currently no economical method for recovering the fine phosphate particle portion. The waste clay and fine phosphate would then be routed to a 450-ft diameter thickener, a large tank with internal components which direct and segregate the clay slurry to provide a more concentrated effluent stream (underflow) and a clarified liquid in the other stream. The underflow would be pumped for disposal as clay waste, while the overflow would be returned to the process water flow.

Material from the feed preparation area would be further processed by flotation (Figure 2-20). During the initial "rougher" flotation, the feed would be dewatered, conditioned with fatty acid and other reagents, and fed to flotation machines designed to separate the phosphate from the quartz sand particles. The phosphate particles collected from the "rougher" stage of concentration would be dewatered, scrubbed with sulfuric acid, and washed free of organics and other material with fresh water prior to the second or "amine" flotation stage. In this stage the material would be conditioned with amine and other reagents which coat the quartz sand. The remaining quartz sand would then be floated away from the phosphate, resulting in an upgraded final phosphate concentrate product.

The rinsing before amine flotation and the dilution water added to the amine cells are the main uses of fresh (deep well) water in the process (6.03 mgd). Recycle water utilized for this function would upset the process and result in an unacceptable phosphate product. The reagents used in processing attach to the quartz sand waste (tailings) particles or remain in the rinse water which would flow to join the waste clay disposal stream. The wet pebble and concentration products from the washer and flotation areas, respectively, would be transferred by conveyor belts to outdoor storage piles. Wet rock would be withdrawn or reclaimed from storage by means of a conveyor located inside a tunnel

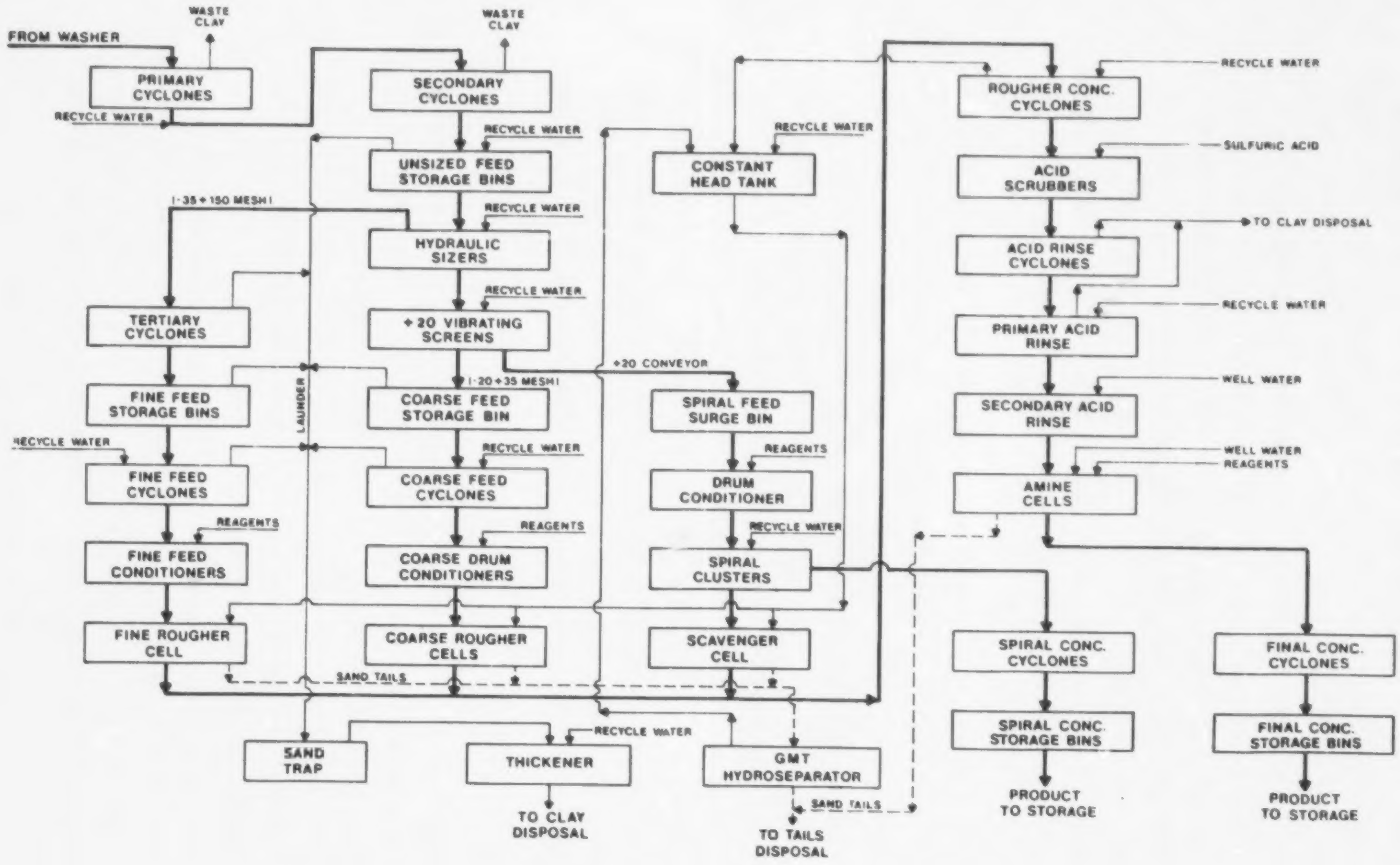


FIGURE 2-20. FARMLAND INDUSTRIES, INC. FEED PREPARATION AND FLOTATION FLOWSHEET.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

under the storage pile. Any drainage from the stored rock would be returned to the beneficiation plant circuit.

2.3.1.2 Environmental Considerations

Environmental Advantages. Because the processing operations are done in a wet state, the plant would have no significant air emissions.

Environmental Disadvantages. The feed preparation area of the plant will produce a liquid waste stream containing waste clays at about 3 percent solids. Disposal of these clays will require that they be impounded within diked settling areas to dewater, presenting significant waste disposal problems.

The amine flotation area of the plant will require the use of large amounts (6.03 mgd) of fresh water from deep wells, resulting in a lowering of the potentiometric surface of the Floridan Aquifer.

Conventional processing also utilizes various reagents to aid in the separation of the various matrix fractions. Although some of the reagents used in processing attach to the sand tailings, a portion remain in the rinse water and flow to the waste disposal areas with the waste clays. Some portion of these reagents will volatilize from the waste disposal areas, while others will be adsorbed by the clays themselves. However, very small quantities will also be present in the effluent discharge.

2.3.2 DRY MATRIX PROCESSING

2.3.2.1 General Description

The general concept of dry processing involves the production of usable phosphate product from matrix--directly following its excavation and drying. Matrix would be trucked, conveyed, or through some other means transported to the beneficiation plant. There it would be dried, crushed, and sized to minus 1 mm before the finer components (mostly clay) were separated from the coarser in an air separator. Several stages of separation would be required to efficiently separate the fine clay from the dried and crushed matrix. The phosphate product would then be separated from the remaining coarser material by an electrostatic separator. The product distribution would be approximately 1/4 fine dust, 1/2 quartz sand, and 1/4 phosphate product.

2.3.2.2 Environmental Considerations

Environmental Advantages. Dry matrix processing would reduce groundwater withdrawals and eliminate the environmental hazards of large diked areas now used for the clarification of water used in conventional matrix processing. Dry processing of matrix would also significantly reduce the volume of clay waste due to absence of entrained water. In addition, recovery of phosphate from the matrix could also be increased if a portion of the phosphate fines which are disposed of with waste clays in conventional processing could be retained at the plant as product.

Environmental Disadvantages. Dry matrix processing would be extremely energy consumptive. Matrix from the mine contains about 19 percent water and would have to be dried before dry processing, consuming about 70 million gallons of fuel per year. The burning of such large amounts of fuel would result in significantly more air emissions than for a conventional plant. The handling and disposal of dry waste materials would also result in increased particulate emissions in the site area.

2.3.2.3 Technical Considerations

Dry matrix processing is currently in use in at least one foreign phosphate plant. However, the matrix from this foreign operation is of low moisture content (coming from a dry underground mine), the phosphate content is extremely high (as compared to Florida matrix), and electrostatic separation is not required. Over the past several decades, attempts have been made to develop a dry process for Florida matrix. Although it is said to be technically feasible, it has not yet been proven practical.

2.3.4 SUMMARY COMPARISON - MATRIX PROCESSING

Both conventional and dry matrix processing present significant environmental disadvantages, the former in terms of water consumption and the latter in terms of energy consumption and air emissions. It appears that conventional processing may be somewhat less environmentally disadvantageous, although future technological developments may improve the aspect for dry processing.

2.4 WASTE SAND AND CLAY DISPOSAL

Disposal of waste from matrix processing is a particularly difficult problem confounding the industry. There are two waste sand and clay disposal methods currently in use. These are sand-clay mixing and conventional sand and clay disposal. Both methods entail the commitment of vast acreages of land to very limited use, at least in the short term; and both involve the use of dikes and impoundments--all or part of which may be above grade. Dikes are subject to potential failures, however remote the likelihood, while impoundments entrap rainfall and surface water flows, resulting in the need to discharge effluent to surface waters. These impacts will occur to a greater or lesser degree regardless of the disposal method employed. There are, however, specific characteristics associated with each alternative waste sand and clay disposal method which offer environmental advantages and disadvantages when compared to one another. A general description of each waste sand and clay disposal alternative is presented below, followed by environmental considerations. Where additional information is required to complete the evaluation, technical and economic considerations are provided. Lastly, a summary comparison is presented to identify the environmentally preferable alternative.

2.4.1 SAND-CLAY MIXING (FARMLAND'S PROPOSED ACTION)

2.4.1.1 General Description

The majority of the sand and clay wastes from the beneficiation plant would be disposed of through the sand-clay mix technique (Figure 2-6). Refinement of sand-clay mixing techniques is presently receiving research emphasis from the industry. Brewster Phosphates has been one of the pioneers in developing field scale models of sand-clay mixing. Their method of obtaining a sand-clay mix involves the placement of clay slurry from the beneficiation plant into mine cuts where they are allowed to settle to 12-15 percent solids. Sand tailings are then sprayed over the consolidated clays. The sand penetrates and mixes with the clays, liberating water and producing a thick sand-clay mixture. After the mixture has consolidated, overburden from adjacent spoils piles is spread over the surface and graded. Use of this method has not been totally successful to date, but work is continuing on its development.

During the early years of mining, Farmland plans to experiment with the most up to date techniques available and select the technique that is best suited to the conditions at their mine. The sand-clay mixing would start in the south-central portion of the property in year 4, and progress to the other mined-out areas throughout the life of the mine. The water used to transport the clay and tailings sand would return to the mine water recirculating system by a system of ditches and spillways. Since the mining and sand-clay disposal areas would constantly be relocated, the mine water recirculation system would also undergo frequent rerouting. In addition to sand-clay mix areas, two separate clay disposal and two separate sand tailings disposal areas are also planned (Figure 2-6). These separate disposal areas are necessary for two reasons:

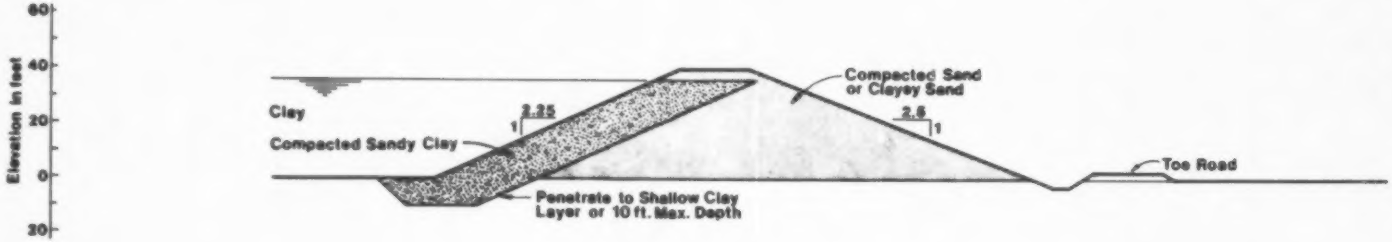
- In the startup phase of the operation, there would be no below-ground area available for waste disposal; therefore, the waste clays must initially be stored in an impoundment constructed on natural ground (Settling Area I--Figure 2-6).

- Since the sand and clay content of the ore varies considerably, it will not be possible to achieve the proper mixing ratio on a continuous basis. Therefore, separate disposal areas will be necessary to receive either sand or clay wastes periodically generated in excess of the capabilities of the sand-clay mix process (Area II--Figure 2-6).

The clay retention dams are planned to have an average height of 41 ft above-grade, but filled no higher than 35 ft (Figures 2-21 and 2-22). As currently planned, Settling Area I (Figure 2-7) will occupy 495 acres and Settling Area II, 583 acres. Phosphatic clays pumped to the settling areas as a slurry of approximately 3 percent solids would, over a period of 10 years or more, settle to 18 to 20 percent solids. The ore underlying the clays stored in Settling Area I would be mined during the last few years of mining. Prior to this, the overlying clays (thickened by dewatering over the years) would be dredged and used in sand-clay mixing or deposited within Area II. Area II is expected to remain active through the life of the mine.

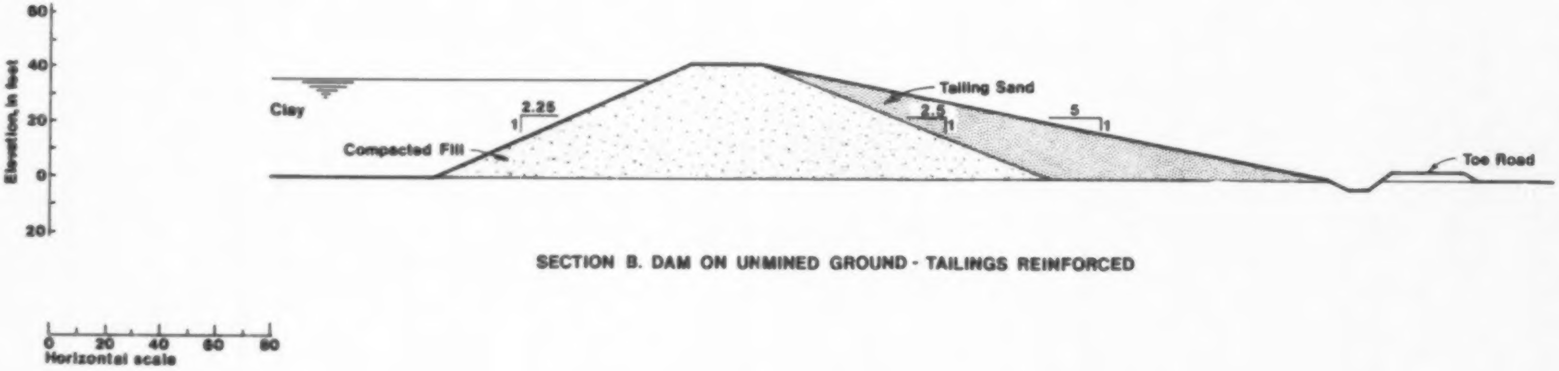
Sand-clay mix will be deposited over most of the mine site (3915 acres of the 4591 mined). Sand-clay mixing ratios ranging from 1.9:1 to 3.1:1 sand to clay are planned, depending primarily on the relative proportions of sand and clay generated by the beneficiation process. The average mixing ratio will be somewhat less than the average sand to clay ratio of 2.6:1 for the ore body as a whole.

Sand-clay landfills are expected to undergo an initial period of rapid dewatering and subsidence followed by a prolonged period of gradual consolidation and further subsidence. In order to allow for this subsidence, it is essential that sand-clay landfills be filled initially to above natural grade. The level of backfilling will be used to determine the final drainage characteristics of the subsided landfills. In areas where it is desirable to achieve a high proportion of well-drained land, the level of backfilling will be adjusted so that the landfill will ultimately subside to slightly above original grade. When it is desirable to restore a hydric environment during reclamation, the



60
40
20
0
20
Elevation in feet
Clay
Compacted Sandy Clay
2.25
1
Penetrate to Shallow Clay Layer or 10 ft. Max. Depth
Compacted Sand or Clayey Sand
2.5
1
Toe Road

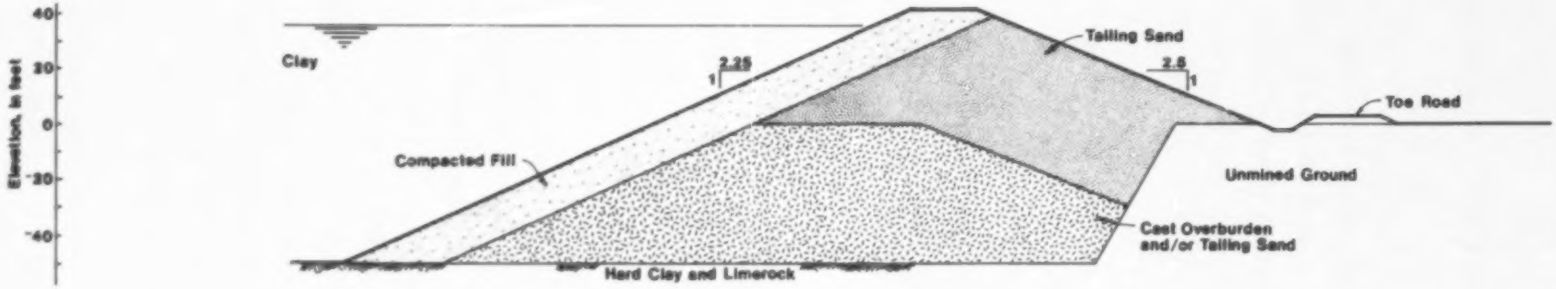
SECTION A. DAM ON UNMINED GROUND



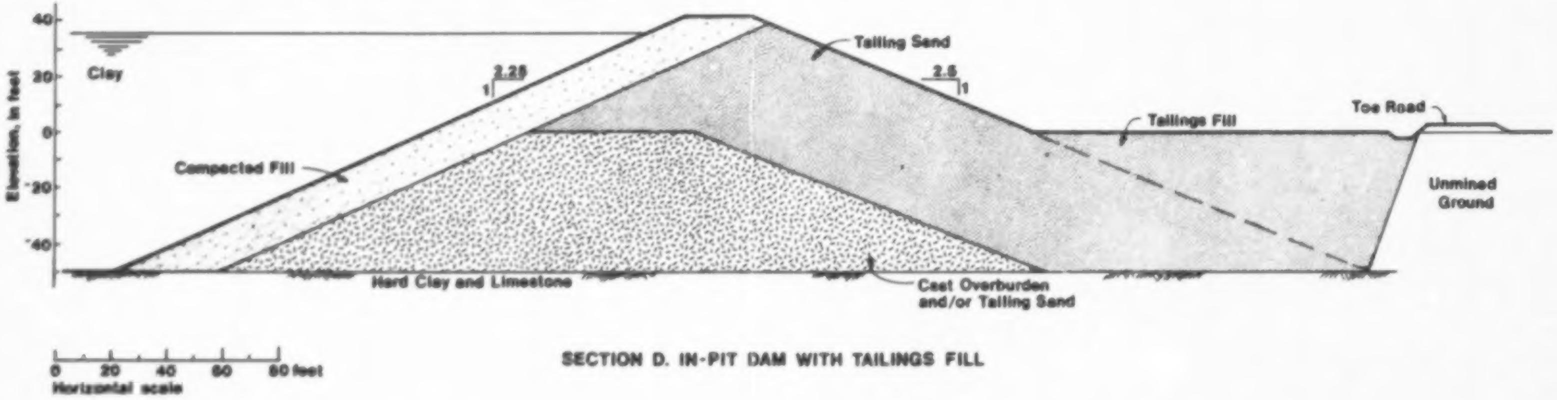
SECTION B. DAM ON UNMINED GROUND - TAILINGS REINFORCED

FIGURE 2-21. RETENTION DAM DESIGN FOR CLAY IMPOUNDMENT AREAS ON UNMINED GROUND.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979



SECTION C. IN-PIT DAM - TAILINGS REINFORCED



SECTION D. IN-PIT DAM WITH TAILINGS FILL

FIGURE 2-22. RETENTION DAM DESIGN FOR CLAY IMPOUNDMENTS ON MINED GROUND.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

level of backfilling will be adjusted to allow for subsidence to near or slightly below existing grade.

In order to meet economic goals for the reclaimed site, Farmland determined that the majority of sand-clay landfills should be backfilled to provide a high proportion of well-drained land that will be suitable for a variety of agricultural uses after reclamation. Of the 27 sand-clay landfills shown in Figure 2-6, 25 will be of this type and will cover approximately 3628 acres. Twenty of these landfills will be enclosed by dikes averaging 17.5 ft in height and filled to an average height of 11.5 ft above natural ground level to allow for 6.0 ft of freeboard. The five remaining landfills of this type will be enclosed by dikes averaging 20.0 ft in height and filled to an average height of 14.0 ft above natural ground (Figure 2-23). Farmland indicates that subsidence will eventually bring these landfills to approximately 2.0-3.0 ft above natural ground level.

Figure 2-24 depicts the filling of a typical sand-clay landfill. Sand and clay introduced into the mine cuts in aqueous suspension will be routed around protruding spoil piles toward the outlet end. During this filling stage, clarified water will be drawn off at the outlet and routed back into the mine water recirculation system. As the landfill mixture consolidates, the inlet pipe will be moved either over the landfill itself or over the protruding spoils. Due to the tendency of fine clay particles to remain in suspension longer than the coarser particles, the areas more distant from the inflow point, especially the area immediately around the outlet spillway, are expected to fill primarily with clays. These areas, therefore, will tend to subside more than the rest of the landfill and will, unless corrected by stage filling or grading of spoils, form areas where ponded water will stand for a significant portion of the year. Similar depressions are known to form around the outlet spillways in traditional clay settling areas.

The size of the depressions will depend on the size of the landfill and the engineered elevation of the outfall. In general, the area of

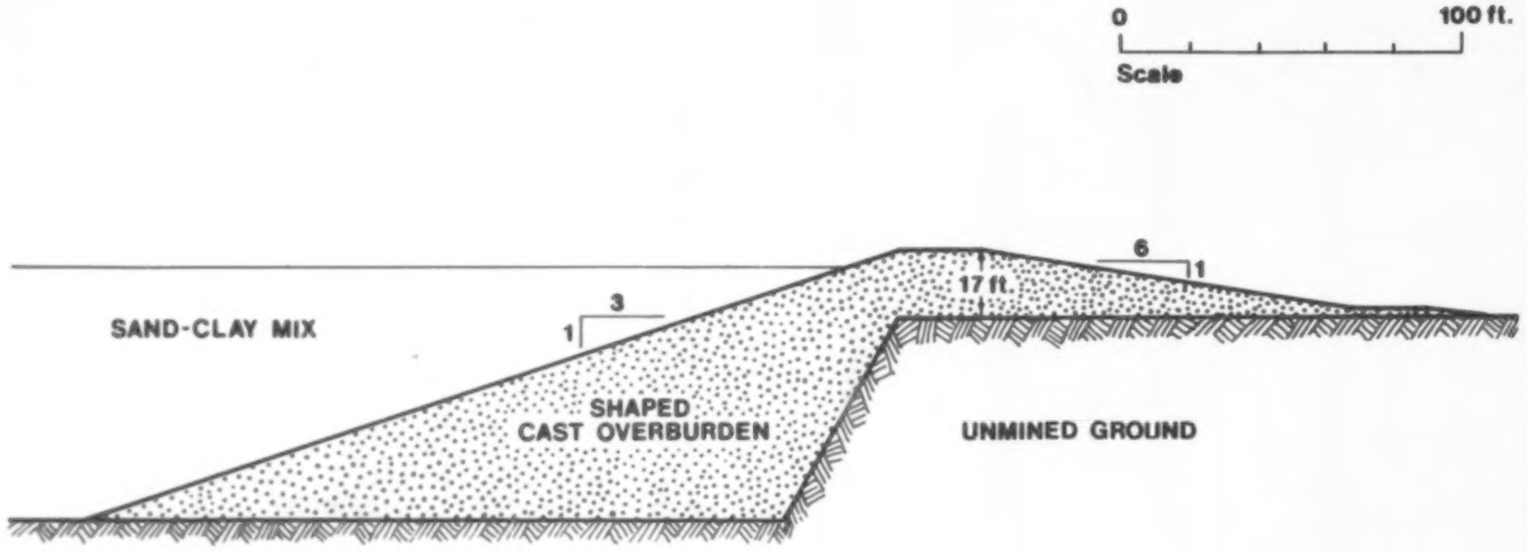


FIGURE 2-23 RETENTION DAM DESIGN FOR SAND-CLAY MIX LANDFILLS IN MINED-OUT AREAS.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

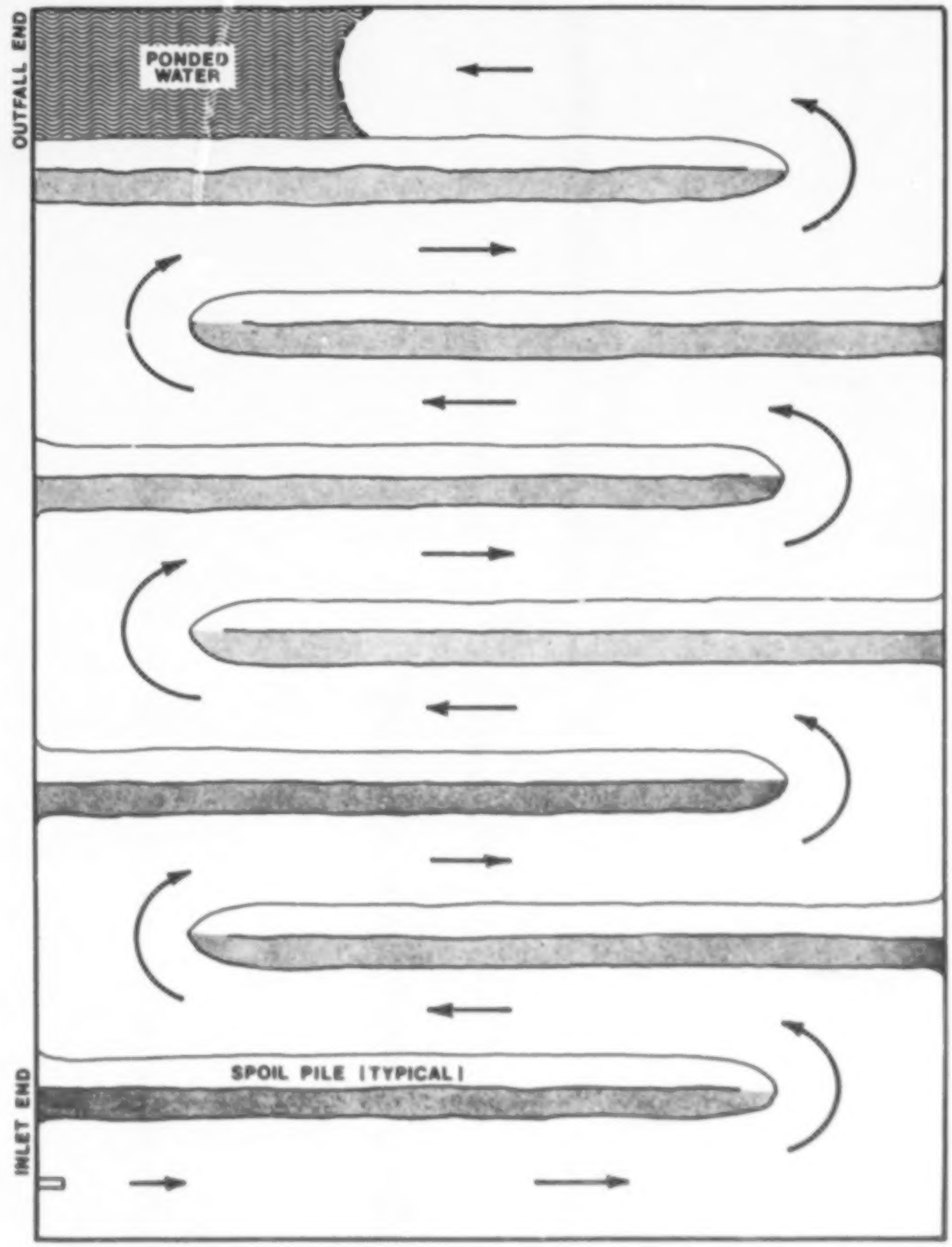


FIGURE 2-24. FILLING OF SAND-CLAY LANDFILL.

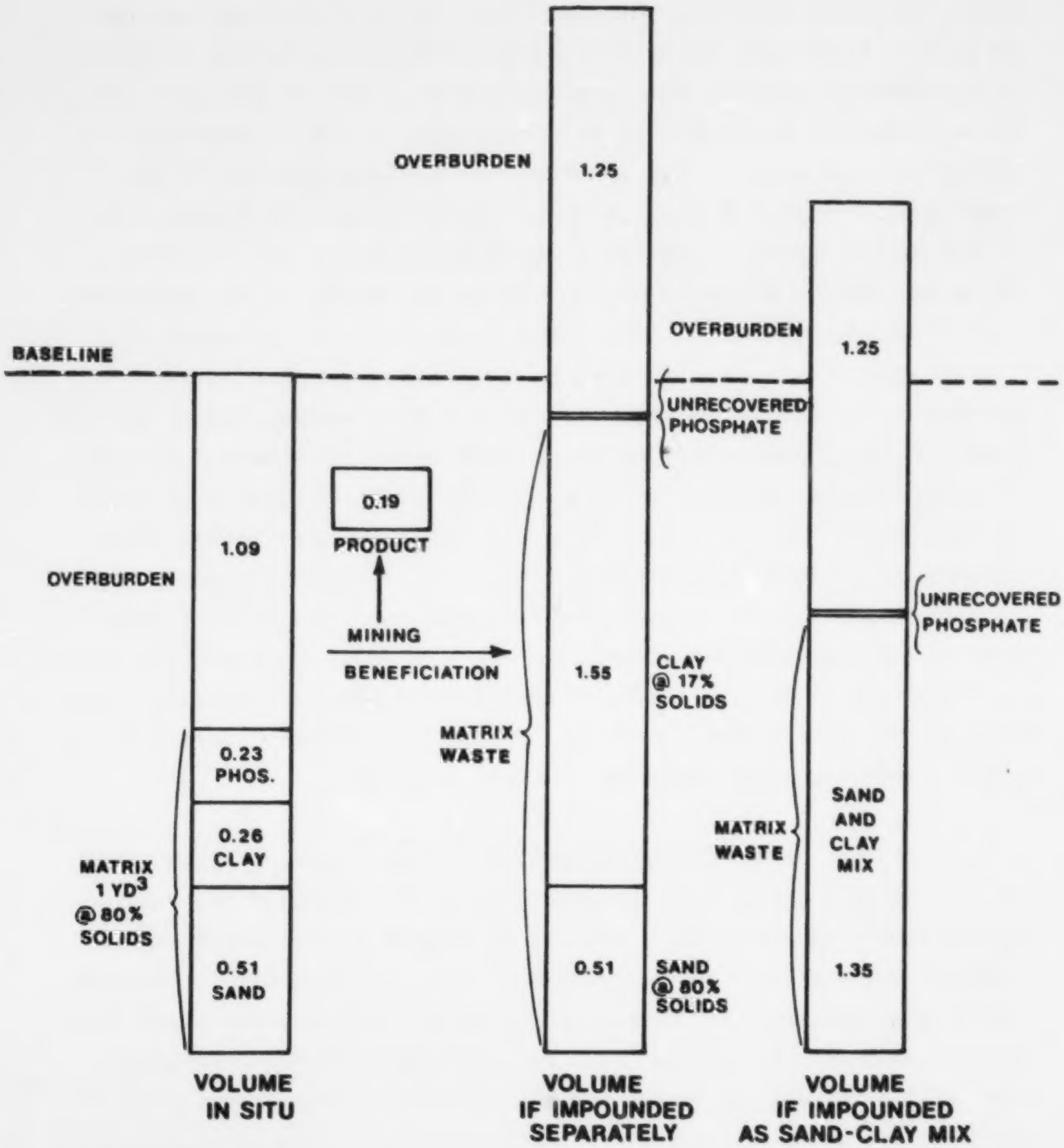
SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

hydric influence will be within the final mine cut, although the area subject to inundation can be made larger or smaller according to design. It is currently planned that approximately 5 percent of the total area in sand-clay landfills will be within the area of hydric influence. Since these depressions will be located at the downslope end of the sand-clay landfills, drainage will be naturally directed through them. In two of the sand-clay landfills, special techniques will be used. These two special mix areas are labeled as Special Mix 1 and Special Mix 2 in Figure 2-6. During active mining of these areas, the water flow through each of the two channels will be diverted into previously prepared channels outside the mining area. After mining, levees approximately 11 ft in height will be constructed around these areas and sand-clay mix introduced into them to an average height of about 6 ft above natural grade. In order to speed up the subsidence and thereby allow reclamation of these environmental restoration areas to proceed at a more rapid pace, clays dredged from Settling Area I are planned to be used in the sand-clay mix. Dredged clays will enter the landfills at approximately 18 percent solids as opposed to 4 percent solids for clays used in normal sand-clay landfills. The use of thickened clays will promote more rapid consolidation of these landfills.

Subsidence will bring the special mix areas to near original grade on the average, but greater subsidence where the sand-clay fill is the thickest will result in the center of the filled mining cuts being slightly below grade. This gradually sloping land around the protruding spoil piles will in effect create broad swales approximately 150 ft wide running east-west in Special Mix 1 and north-south in Special Mix 2. The spoil piles will be graded and the entire area revegetated prior to introduction of flow-through water into the areas.

2.4.1.2 Environmental Considerations

Environmental Advantages. Since sand-clay mix is expected to consolidate more than separately stored sand and clay (Figure 2-25), the use of sand-clay mix techniques should also result in a final surface that more



NOTE: VOLUMES ARE IN YD³.
0.19 YD³ OF PRODUCT = 0.25 TONS OF PRODUCT.

FIGURE 2-25. MATRIX COMPOSITION AND WASTE VOLUME RELATIONSHIPS.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

closely approximates the original surface in both contour and elevation, and the stability of these areas should allow for greater long-term land use potential than areas of separately stored clay wastes. In addition, the use of sand-clay mixing should allow for more rapid dewatering of the clays--providing more water for recycling and reducing the extent to which the clays would flow over land in the event of a dike failure.

Environmental Disadvantages. Because entrained water losses from the system will most likely be less using sand-clay mix methods than for conventional methods, there should be a greater chance that a discharge from the facility will be required during periods of heavy rainfall.

It is possible that the stability of sand-clay mix areas will be such that these areas are not suitable for some uses (e.g., buildings). By using sand-clay mix methods, the resultant acreage of such limited-use areas on the site might be greater than if these wastes had been disposed of in separate areas using tested reclamation techniques.

In addition, it is estimated that 30 percent of the phosphate content of the matrix remains with the clay waste using current matrix processing techniques. Research is currently underway to develop the technology to recover these phosphate resources. By diluting the phosphate bearing clays with tailings sand, the ease of remining and economic feasibility of reprocessing for recovery of this phosphate resource will be diminished.

2.4.2 CONVENTIONAL SAND AND CLAY DISPOSAL

Sand-clay mixings will also be more energy intensive (on the order of 160 percent) than conventional sand and clay disposal. This additional energy requirement results largely from the need to transport the waste materials greater distances than would be the case with conventional disposal methods.

2.4.2.1 General Description

Conventional sand and clay disposal involves the disposal of these wastes in separate diked impoundments. Waste sands pose no disposal problem, for they dewater rapidly and can be used in the filling of mined areas without difficulty. Clays, on the other hand, would enter the disposal area at about 3 percent solids and would require a long period of impoundment to dewater to any significant degree. Most of the material deposited would not reach a density of more than 30 percent solids in the foreseeable future. After the clays had settled and compacted over a period of several years, these areas would generally be left to revegetate naturally or be reclaimed as pasture by controlling surface drainage.

If Farmland utilized conventional waste disposal methods, separately impounded waste clays would cover about 2500 acres of the site. This area would eventually contain impounded clays to a height of 35 ft above ground. The total acreage would be comprised of three major impoundment areas ranging from 350 to 750 acres in size. Diking requirements for these areas would be major (about 12 miles of 40 ft dikes would be required).

2.4.2.2 Environmental Considerations

Environmental Advantages. The large pond areas used for clay settling would consume water via entrainment--reducing the potential for a need to discharge to surface waters. Process waters contained within clay settling areas would also be separated from the underlying Surficial Aquifer by the relatively impervious clays themselves--minimizing the chance of Surficial Aquifer contamination by mining and beneficiation reagents. The extent to which such reagents would move into the adjacent Surficial Aquifer when placed in sand-clay mix disposal areas is uncertain.

While the potential uses of reclaimed clay settling areas would be limited, other areas not utilized for clay disposal could be reclaimed in a variety of ways based on years of phosphate reclamation experience. By contrast, long-term reclamation limits of sand-clay mixes are untested.

Environmental Disadvantages. Relative to sand-clay mix impoundments, the clay impoundments present increased potential for severe pollution of surface water by clays released as a result of a dike failure. Should a clay impoundment dike fail, as much as two-thirds of the impounded clays (in a very fluid state) would escape. For one impoundment area of 600 acres, this would amount to about 11,500 acre-feet of unconsolidated clay waste. The area affected by such a release would cover approximately 6 square miles. These would likely enter adjacent surface waters--resulting in the destruction of both plant and animal life in the affected areas.

2.4.4 SUMMARY COMPARISON - WASTE DISPOSAL

Both conventional and sand-clay mix waste disposal methods pose environmental problems. Moreover, it must be recognized that the proposed sand-clay mix disposal plan by necessity incorporates conventional clay settling methodology to some extent (Settling Areas I and II), and to a corresponding degree reflects the environmental disadvantages of the conventional waste disposal method. However, the overall environmental advantages of sand-clay mix waste disposal (e.g., improved post-mining topography, more rapid dewatering and increased water recycling, decreased dike and fill heights, and reduced dike failure hazard) clearly make it the environmentally preferable waste sand and clay disposal alternative.

2.5 PROCESS WATER SOURCES

The process water flow using conventional matrix processing methods for the Farmland project would be about 72 mgd, most (90 percent) of which is recycled water. However, processing requires a continuous supply of fresh water. Most of this (6.03 mgd of the total 9.21 mgd required) is required for the amine flotation segment of matrix processing. The remainder is required as make-up for losses which are incurred. There are two* alternative water sources which can be utilized for processing requirements. These are groundwater withdrawal and surface water impoundment. A general description of each process water source alternative is presented below, followed by environmental considerations. Lastly, a summary comparison is presented to identify the environmentally preferable alternative.

2.5.1 GROUNDWATER WITHDRAWAL (FARMLAND'S PROPOSED ACTION)

2.5.1.1 General Description

The major source of water used at the mine would be from onsite deep wells (Figure 2-9). The well field at the mine would likely consist of a primary production well, standby production well, and a potable water well. The production wells would be drilled to a depth of approximately 1400 ft (Figure 2-8) and have a maximum capacity of 6200 gpm. An average daily pumping rate of 5075 gpm is planned for the production well in use. The potable water supply well would have a design capacity of 250 gpm and an average daily pumping rate of 15 gpm.

Process water withdrawals over the life of the mine can be described in three phases, which are described in the following paragraphs.

Phase I. The Phase I water demand will be the requirement for pre-filling Settling Area I. The pre-filling is necessary to offset delayed water release by clays on start-up of the mining operation. The quantity of water for pre-filling is based on a maximum deep well rate of approximately 6200 gpm for 365 days (8.93 mgd average). The water level in Settling Area I will be maintained at an elevation sufficient to provide rapid flow return to the plant water pool upon start-up.

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*A potential third alternative, combined groundwater and surface water, is not considered feasible in the case of the Farmland project because the seasonal low flows of onsite streams preclude the opportunity for diversion of significant amounts of surface water to processing while maintaining the stream system. Therefore, any combination would require impoundment and therefore would reflect the environmental disadvantages of both methods.

Phase II. The second phase covers the start-up years, or period of greatest water retention by the waste clays, based on conventional clay disposal with solids reaching 17 percent and smaller catchment areas than will exist in the later years of mining. The quantity of water required will be 8.85 mgd: 8.83 mgd for rock processing plus 0.02 mgd for potable water.

Phase III. During the third phase, the planned sand-clay mix treatment is expected to reduce the deep well water requirements by returning more water to the system due to increased solidification of the clays and partial capture of the released, interstitial water from sand tailings. The effectiveness of the sand-clay mix technique in releasing adsorbed water from the clays has not been defined and requires full-scale development and testing. Experimentation with the procedure will begin early in the project to insure that the process will be developed and in routine use at an early date. The degree of success for water recovery improvements is not known at this time; therefore, the estimated groundwater demand is shown only as a quantity equal to or less than that required during conventional clay disposal (Phase II).

2.5.1.2 Environmental Considerations

Environmental Advantages. The use of groundwater, rather than surface water, as a process water source would allow surface waters of the Peace River system to be available for other downstream users. Maintaining flows in adjacent streams and rivers would also eliminate the impacts on aquatic biota that could result from reduced surface water flows.

Environmental Disadvantages. Groundwater pumping would lower the potentiometric surface of the Floridan Aquifer in the site area, resulting in adverse impacts on the aquifer. More energy would be required to pump groundwater from deep wells than from nearby surface water sources.

2.5.2 SURFACE WATER IMPOUNDMENT

2.5.2.1 General Description

The most readily available water source which could be utilized by Farmland would be surface water from the nearby creeks and rivers. Since the creeks on the site typically exhibit low flows, or even intermittent flows, the quantity available for use as process water could only be provided by impoundment. Surface water could be stored and used to reduce the amount of groundwater withdrawn. Farmland's proposed rainfall collection facilities include only those structures which are a part of the mining, waste disposal, and water clarification and recirculation plans (amounting to a nominal average of 10.6 cfs of normal rainfall). In order to improve the collection of such water for use in the facility processes, additional catchment areas (or reservoirs) could be provided in the main drainage areas of the mine property to collect above normal flows. Such a reservoir system would probably best operate with the normal level at elevation 65 ft, allowing an additional 5 ft for emergency capacity for heavy rainfall periods. Such a reservoir system could also receive clarified excess water from the clay disposal area, should such release be necessary.

2.5.2.2 Environmental Considerations

Environmental Advantages. Use of surface water as the primary process water source would preclude the lowering of the potentiometric surface of the Floridan Aquifer. The use of reservoirs to store excess clarified water from the recirculating system would also reduce the potential for a direct discharge to Oak Creek or Hickory Creek.

In addition, such reservoirs would provide more than 1000 acres of lacustrine habitat for associated aquatic plant and animal species. Hardee County currently has no water bodies of this size. However, long-term habitat and water quality characteristics of these reservoirs are uncertain.

Environmental Disadvantages. The most suitable sites for reservoir construction on the Farmland site are in those areas which would be preserved by Farmland's proposed mining plan (e.g., Oak Creek Islands).

The retainment of flood flows in these areas for impoundment filling would also alter the characteristics of their downstream floodplains; and in the event of a dike failure, the stored surface water would represent a hazard to downstream areas.

2.5.3 SUMMARY COMPARISON - PROCESS WATER SOURCES

The major environmental impact associated with obtaining process water from groundwater withdrawal is the lowering of the potentiometric surface of the Floridan Aquifer. However, this aspect of the mining operation is thoroughly overseen by the Southwest Florida Water Management District (SWFWMD) which is responsible for determining the permissible amounts of water to be withdrawn by all major users in the SWFWMD region (which includes the Farmland site). The fact that Farmland has been granted a consumptive use permit by SWFWMD is judged to represent their determination that the anticipated effect on the Floridan Aquifer is acceptable. Given all other environmental considerations relative to the two methods, groundwater withdrawal is the environmentally preferable alternative.

2.6 WATER MANAGEMENT PLAN

The large amounts of water (72 mgd) required for the transport and processing of phosphate matrix necessitate that a detailed water balance be developed to help manage its use. Part of this plan must be the capability to reduce the amount of water in the recirculating system (e.g., during periods of heavy rainfall). Excess water could be removed from the system by either discharging to surface waters or to a deep aquifer (via connector wells). A general description of each water management plan alternative is presented below, followed by environmental considerations. Lastly, a summary comparison is presented to identify the environmentally preferable alternative.

2.6.1 DISCHARGE TO SURFACE WATERS (FARMLAND'S PROPOSED ACTION)

2.6.1.1 General Description

The above ground clay settling areas (Areas I and II), sand-clay mix areas, and the mine recirculating water system of dams and spillways constitute Farmland's water clarification facility. Seasonal changes in rainfall and evaporation rates will affect the active water volume of the mine water system. During the pre-filling of Settling Area I and the initial years of mining, especially Phases I and II, the rainfall in excess of evaporation during the rainy season will provide additions to the system and help offset system losses. Conversely, during dry periods the deficit due to evaporation will add to the system losses. The system volume will aid in leveling out these seasonal changes.

Seasonal changes in rainfall and evaporation do not have a direct effect on the water required to operate the mine system, since the demands remain reasonably constant, with variations due mainly to mining rates and clay content of the ore. Seasonal deficits in the mine water system can occur, however, due to the following:

- insufficient reservoir capacity to accumulate rainfall during the wet season to offset evaporation losses during the dry season; and
- insufficient catchment area to offset the deficit between rainfall and evaporation rates.

The mine water system is designed to provide sufficient catchment area and water storage volume to level out seasonal fluctuations in supply by rainfall/evaporation and to prevent variations in groundwater withdrawal rates, especially the need for increased groundwater withdrawal during the dry season. The mine water balance (Figure 2-9) indicates that during active mining and for average annual rainfall/evaporation conditions, the 10-inch deficit in the main water system will be offset by catchment in the mining and reclamation areas (0.62 mgd). Excess accumulation will occur, however, as the total catchment area increases.

Normally, there will be no discharge from the mine recirculating water system, for retention areas will have sufficient surge holding capacity to accommodate normal process flow and rainfall variations. Water will be discharged only during periods of heavy rainfall. Farmland (1981) indicates that this discharge will occur during the months of December-January and June-September and has requested that they be permitted to discharge an annual average of 3.75 mgd to surface waters. The primary discharge would be from the clear water pond to Hickory Creek (Figures 2-10 and 2-11). The amount of water discharged at this location would be about 1.24 mgd (annual average). The maximum flow would be about 16 mgd. A second discharge point would be used for occasional discharges from Settling Area IIA into Oak Creek. Farmland is seeking a permit to discharge about 2.51 mgd to Oak Creek, which includes both the amount discharged from the settling area as well as runoff from previously mined areas.

2.6.1.2 Environmental Considerations

Environmental Advantages. Since all process water to be discharged will first pass through active clay or sand-clay settling areas, contaminants within this water should adsorb onto suspended clay particles in these areas and be retained with the settled clays. Concentrations in waters discharged to surface waters should therefore be minimized.

Environmental Disadvantages. Discharging excess water from the recirculating water system to surface waters would create the potential for release of contaminants to the environment should these not be removed by adsorbtion and settling of the waste clays.

In addition, the discharge of excess water into adjacent surface waters would not mitigate for groundwater pumped to dewater mine pits or as make-up water.

2.6.2 USE OF CONNECTOR WELLS

2.6.2.1 General Description

Connector wells would be located around or ahead of the active mine pit area to dispose of Surficial Aquifer water in a deeper aquifer. New wells would have to be constructed as areas were readied for mining, while those used previously would have to be capped once mining had been completed. The volume of water disposed of would be equal to the mine dewatering flow rate ahead of the active mine. This would be dependent upon the amount of water available and the rate at which the dragline is advancing. New wells would have to be constructed as the mining progressed or was initiated in a new block.

2.6.2.2 Environmental Considerations

Environmental Advantages. The use of connector wells would partially mitigate the lowered head which will occur in the Upper Floridan Aquifer as a result of pumping for mine pit dewatering by replenishing a portion of the process water pumped from the Floridan Aquifer with water from the Surficial Aquifer.

The use of connector wells would also decrease the net property discharge by whatever amount the connector wells drained from the advancing mine area. If this amount equalled the estimated rate of Surficial Aquifer water into the mine pit (500 gpm), the average annual discharge could be reduced by 0.72 mgd.

Environmental Disadvantages. The use of connector wells would provide the potential for contamination of the higher quality water of deep aquifers with lower quality water from the Surficial Aquifer. Parameters of concern would be phosphate, nitrate, and gross alpha levels. Connector wells might also dispose of Surficial Aquifer water which could otherwise be used in place of deep aquifer water.

2.6.3 SUMMARY COMPARISON - WATER MANAGEMENT PLAN

While connector wells offer a means of dewatering the Surficial Aquifer ahead of the mining operation while replenishing a portion of the water pumped from the Floridan Aquifer for matrix processing, potentials exist for degradation of water quality. Surficial Aquifer water from the Farmland site was found to have consistently higher gross alpha levels than water from the Floridan Aquifer. Additional parameters of concern are phosphorus, nitrate, and iron. In that the SWFWMD granted Farmland a permit for the withdrawal of groundwater to meet project needs without stipulating the use of connector wells, the potentials for contamination are judged to outweigh the benefits of deep aquifer recharge. In addition, the use of connector wells would not eliminate the need to discharge in the event of heavy rainfall. Therefore, discharge to surface waters is the environmentally preferable alternative providing that the quality of the discharge is within existing state and Federal water quality criteria and standards (see Table 3-16).

2.7 RECLAMATION PLAN

2.7.1 FARMLAND'S PROPOSED RECLAMATION PLAN

2.7.1.1 General Description

Figure 2-6 shows the reclamation plan proposed by Farmland. The general types of physical restoration which would be employed are as follows:

- Sand-clay mix landfill.
- Crust development on clay settling areas.
- Sand tailings landfill.
- Land and lakes construction.
- Restoration of disturbed natural ground.

Reclamation will proceed over the life of the mine, with the final areas mined being reclaimed in the 24th year after operation begins (Figures 2-26 through 2-31). Reclamation plans for specific areas of the site are described in the following sections.

2.7.1.1.1 Sand-Clay Mix Areas

As indicated in Section 2.4.1, sand-clay mixing will create a diverse land surface which Farmland proposes to reclaim in a variety of ways. Most of the sand-clay mix areas will be filled so that they should be suitable for a variety of agricultural uses after reclamation. These areas, originally filled with sand and clay to 17-20 ft above natural ground level, are expected to subside to a final elevation of 2-3 ft above natural ground level (Figure 2-32). Farmland plans to implement an experimental revegetation program on the first sand-clay mix area that becomes available (Figure 2-33). The experimental planting program will include field crops, forage crops, forest trees, truck crops, and citrus. A wetland revegetation experimental area is also planned.

With the exception of the experimental area in Sand-Clay Mix Area 1, all upland reclaimed areas will initially be vegetated with forage species. Most of these areas (2931 acres) will remain in such plantings as serve as improved pasture acreage in future years (Figure 2-12). Other areas will be planted in trees as they become stabilized. Strip plantings of trees will be made, as shown in Figure 2-34, to divide the areas planted as improved pasture (Figure 2-12). Thus they will serve as aesthetic relief to the landscape, windbreaks for areas that are being row cropped, shade areas for cattle, and travel corridors and cover for wildlife. Mesic species will be planted on the overburden and better-drained sand-clay soils, while more water-tolerant species will be planted in the more poorly-drained sand-clay soils.

Farmland proposes to use special techniques to restore the area through which the flow of Oak Creek and one of its northern tributaries will be restored. After the mining of this area, levees approximately

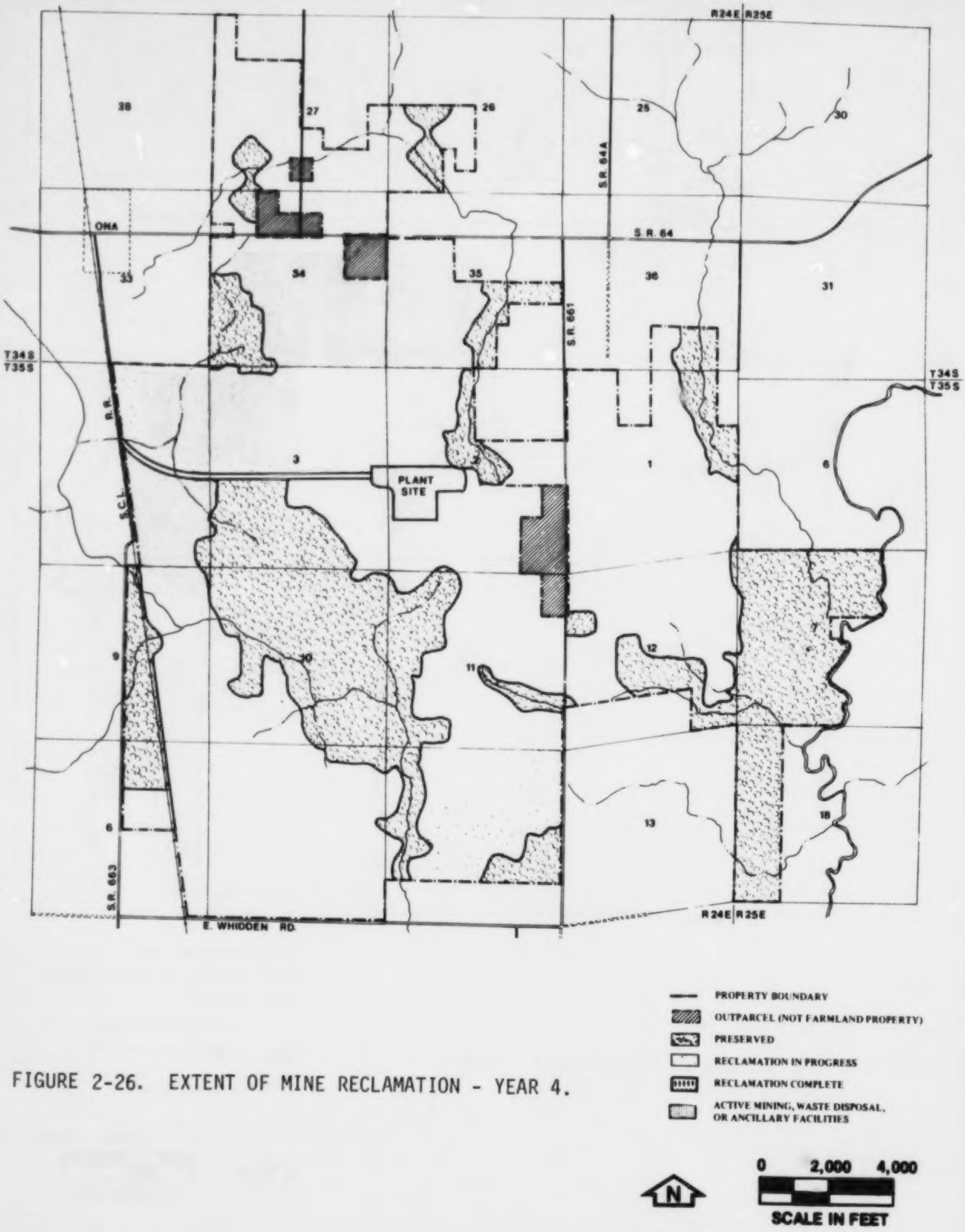


FIGURE 2-26. EXTENT OF MINE RECLAMATION - YEAR 4.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

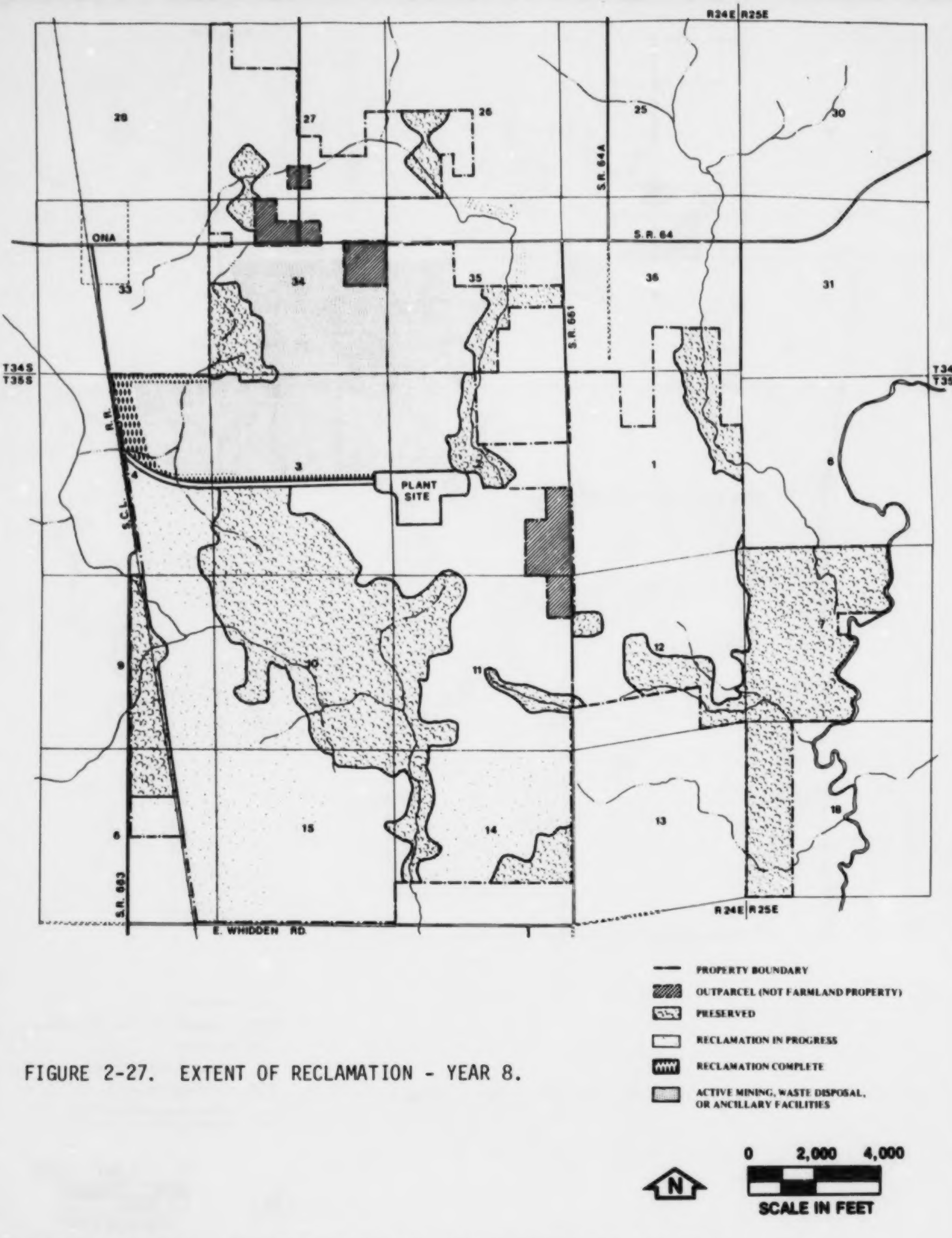


FIGURE 2-27. EXTENT OF RECLAMATION - YEAR 8.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

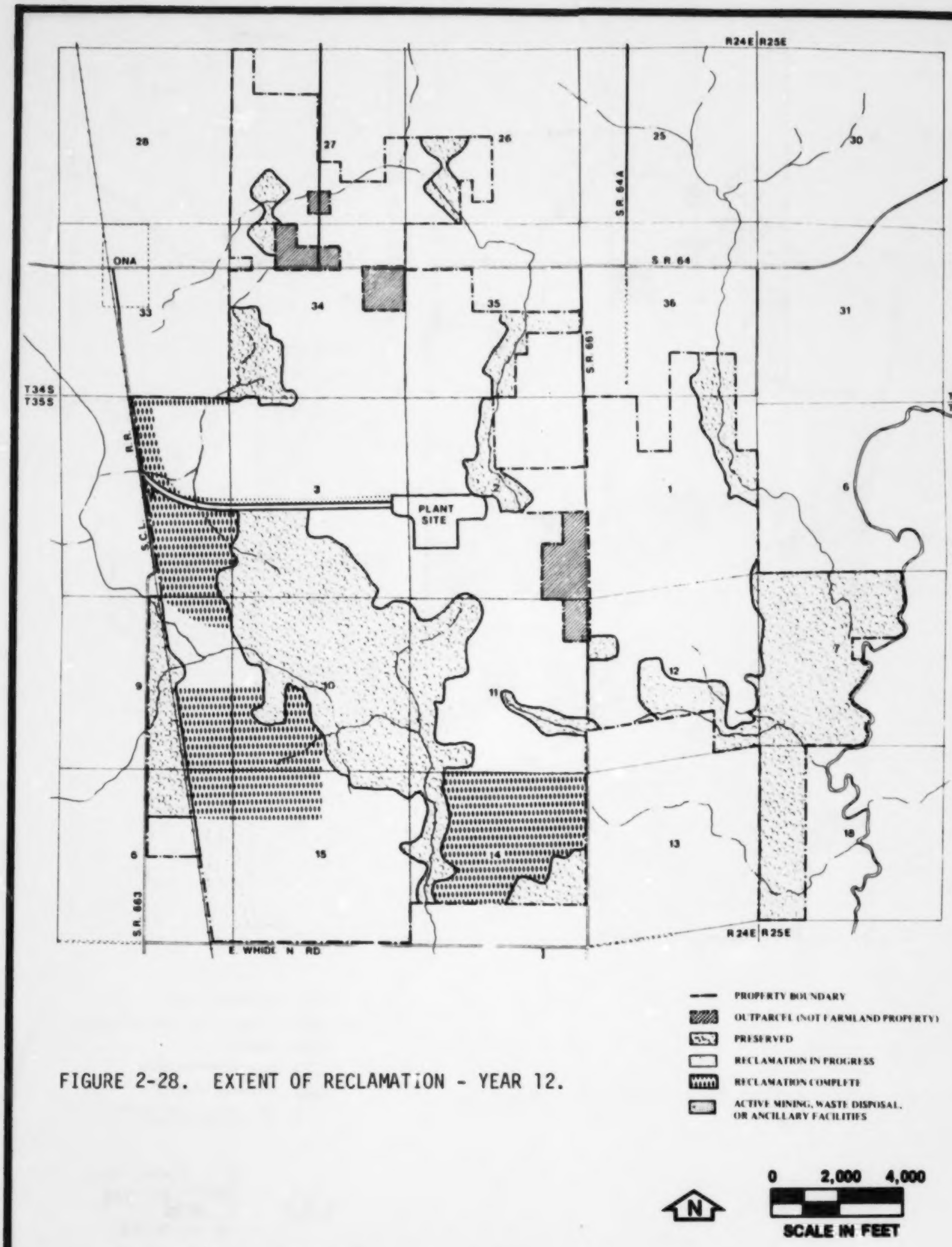


FIGURE 2-28. EXTENT OF RECLAMATION - YEAR 12.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

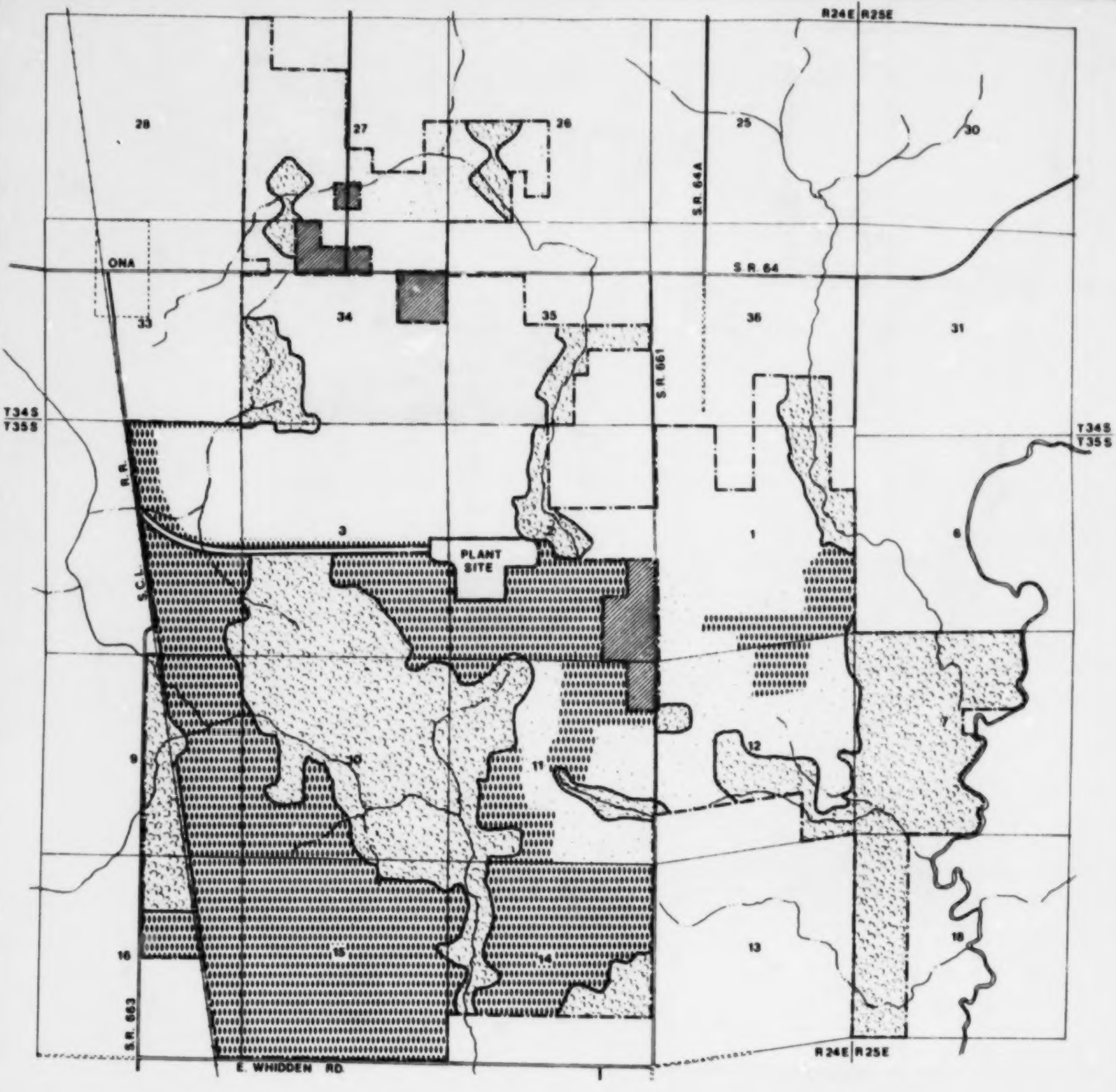


FIGURE 2-29. EXTENT OF RECLAMATION - YEAR 16.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

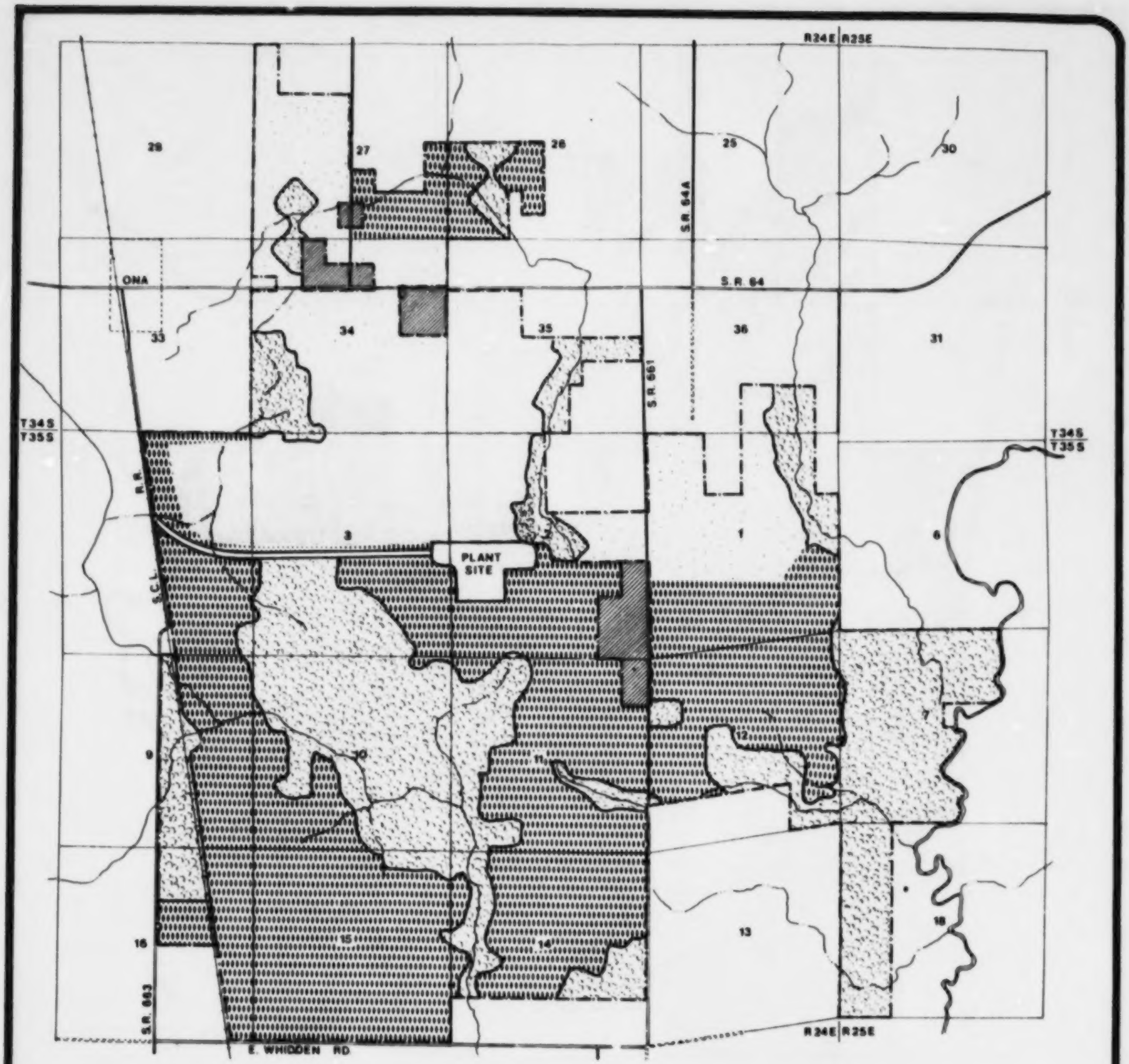


FIGURE 2-30. EXTENT OF RECLAMATION - YEAR 20.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

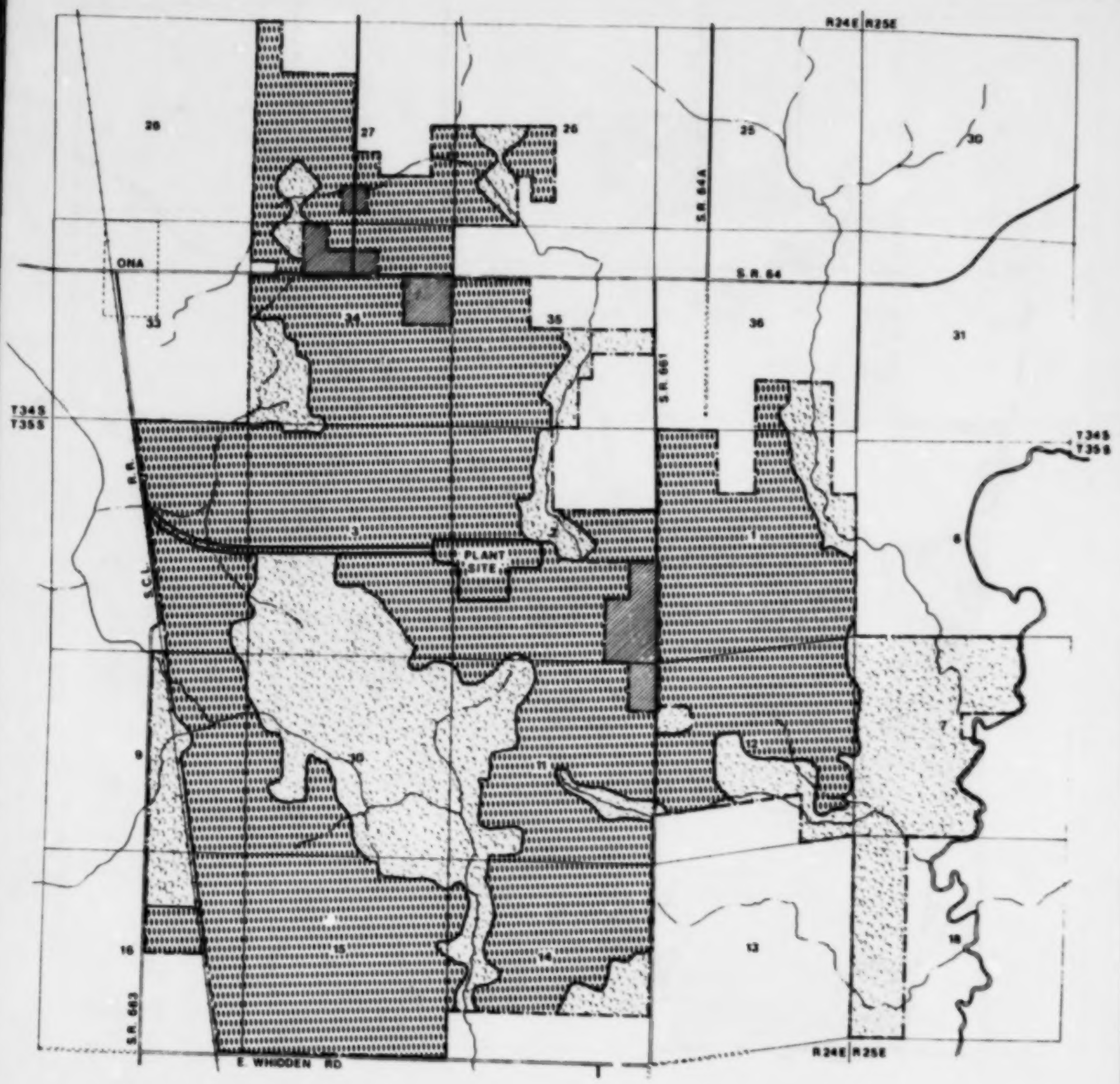


FIGURE 2-31. EXTENT OF RECLAMATION - COMPLETE.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

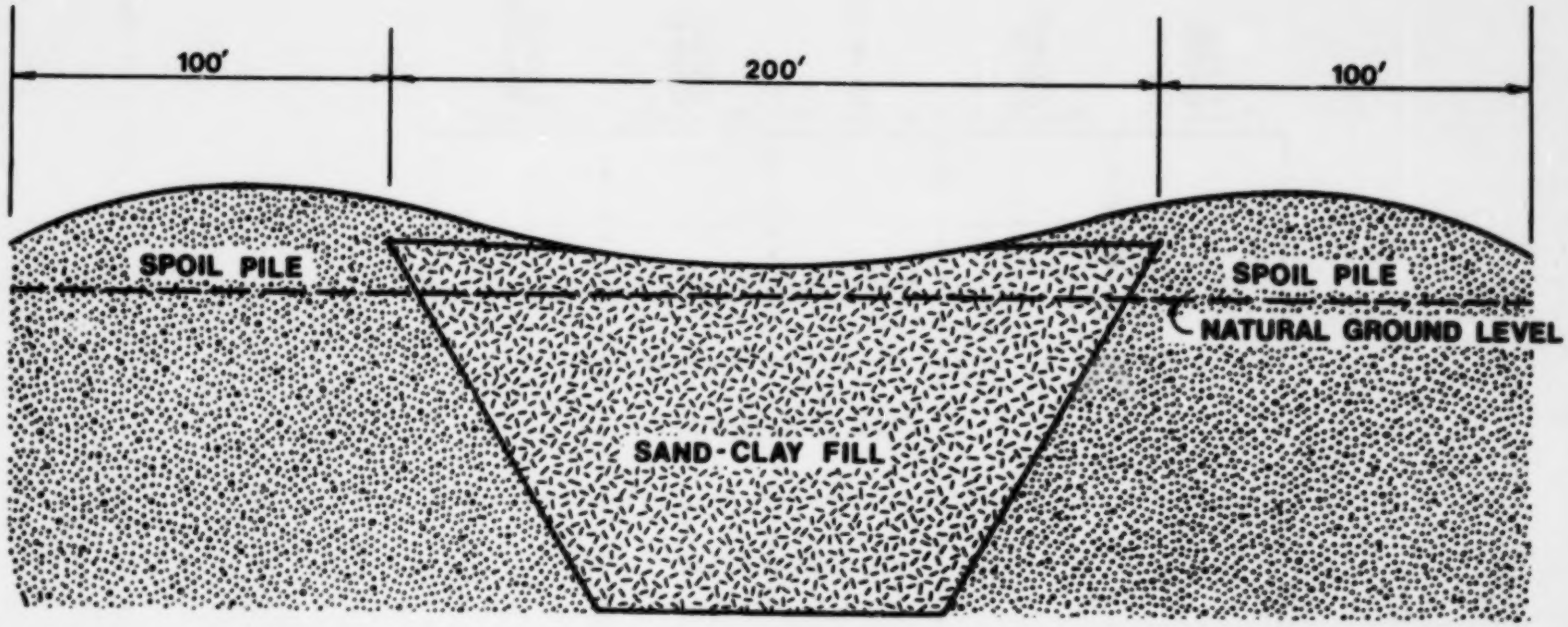


FIGURE 2-32. CROSS-SECTIONAL VIEW OF SAND-CLAY LANDFILL SHOWING SURFACE SOIL CHARACTER AND SUBSIDENCE OF LAND FILL BETWEEN SPOIL PILES.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

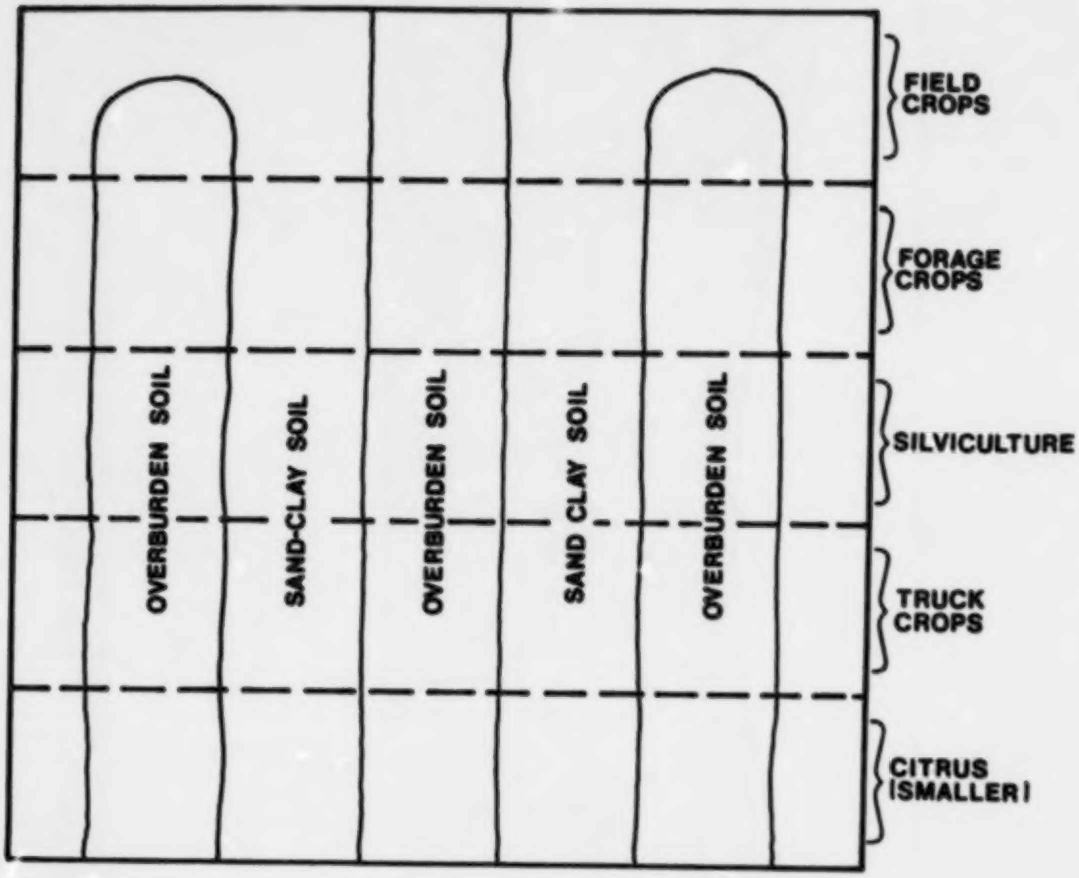


FIGURE 2-33. EXPERIMENTAL PLANTING PATTERN IN SAND-CLAY MIX AREA 1 OF THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

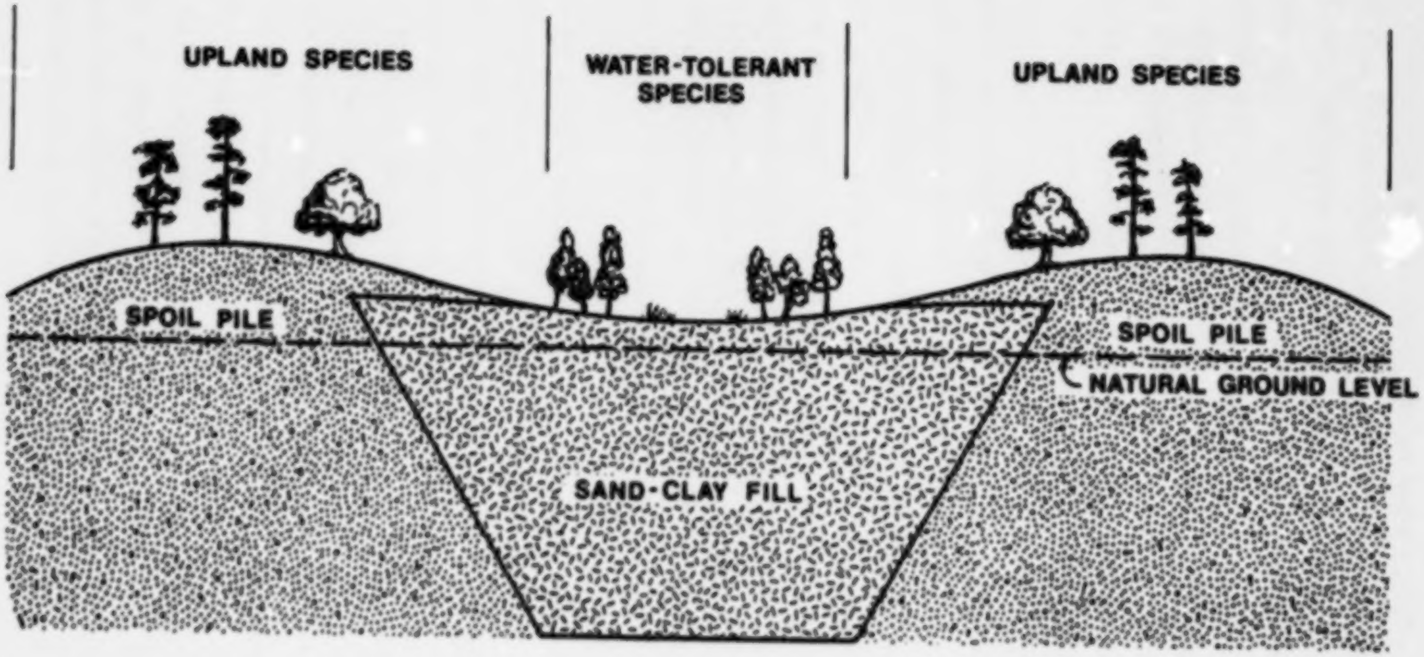


FIGURE 2-34. STRIP REFORESTATION AT A TYPICAL SAND-CLAY LANDFILL, MADE AT RIGHT ANGLES TO THE SPOILING PATTERN.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

11 ft in height will be constructed around these areas, which will then be filled with sand-clay mix to an average height of about 6 ft above natural grade. In order to speed up the subsidence, and thereby allow reclamation of these environmental restoration areas to proceed at a more rapid pace, clays dredged from Settling Area I are planned to be used in the sand-clay mix deposited here. Dredged clays will enter the landfills at approximately 18 percent solids as opposed to 4 percent solids for clays used in normal sand-clay landfills. The thickened clays will promote more rapid consolidation of these landfills. Subsidence will bring the special mix areas to near original grade on the average, but greater subsidence where the sand-clay fill is the thickest will result in the center of the filled mining cuts being slightly below grade as shown in Figure 3-35. This gradually sloping land around the protruding spoil piles will in effect create a broad swale approximately 150 ft wide and resembling a natural floodplain. Spoiling patterns will run east-west in Special Mix 1 and north-south in Special Mix 2 so that a meandering floodplain will be created for each of the restored creek channels. The spoil piles will be graded and the entire area revegetated prior to introduction of flow-through water into the areas.

The reclamation sequence for sand-clay landfills is given in Table 2-1. Filling of sand-clay landfills will take from 1 to 2 years; in general, 2 years will be required for subsidence and consolidation of the landfills. The landfills should have undergone their initial period of rapid subsidence in approximately this time and be sufficiently stable so that the final stages of reclamation can then begin. Allowing an additional 2 years for final grading and revegetation, the total time required for complete reclamation of individual sand-clay landfills should be about 5-6 years. Since reclamation of conventional clay settling areas may require up to 10 years to complete, it is apparent that the use of the sand-clay mix technique should lead to more rapid restoration of disturbed land. The land form of the reclaimed sand-clay mix areas should be a series of graded plateaus such as shown in Figure 2-36.

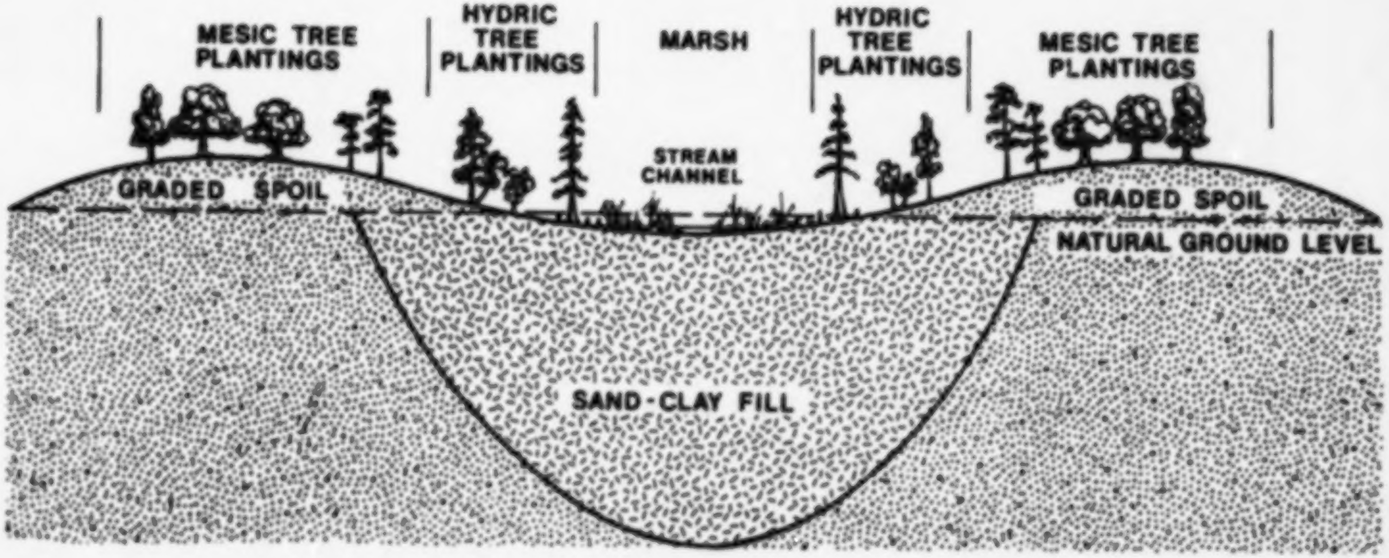


FIGURE 2-35. REFORESTATION OF SPECIAL SAND-CLAY MIX AREAS 1 AND 2.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

Table 2-1. RECLAMATION SEQUENCE AND ACREAGE FOR SAND-CLAY LANDFILLS ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

Landfill*	Acreage	Year of Filling	Year Reclamation Completed
Sand-Clay 1	236	4-5	9
Special Mix 1	181	5-6	10
Sand-Clay 2	103	6-7	11
Sand-Clay 3	75	7	11
Sand-Clay 4	269	7-8	12
Sand-Clay 5	286	8-9	13
Sand-Clay 6	168	9-10	14
Sand-Clay 7	192	10-11	15
Sand-Clay 8	78	11	15
Special Mix 2	106	11	15
Sand-Clay 9	310	12	16
Sand-Clay 10	129	12	16
Sand-Clay 11	137	13	17
Sand-Clay 12	146	13	17
Sand-Clay 13	70	14	18
Sand-Clay 14	215	15	19
Sand-Clay 15	108	15	19
Sand-Clay 16	68	15-16	20
Sand-Clay 17	40	16	20
Sand-Clay 18	130	16	20
Sand-Clay 19	203	17	21
Sand-Clay 20	190	17-18	22
Sand-Clay 21	99	18-19	23
Sand-Clay 22	89	19	23
Sand-Clay 23	68	19	23
Sand-Clay 24	161	19-20	24
Sand-Clay 25	58	20	24
TOTAL	3915		

*See Figure 2-6 for Sand-Clay Mix Landfill Locations.

Source: Farmland Industries, Inc. (1979a).

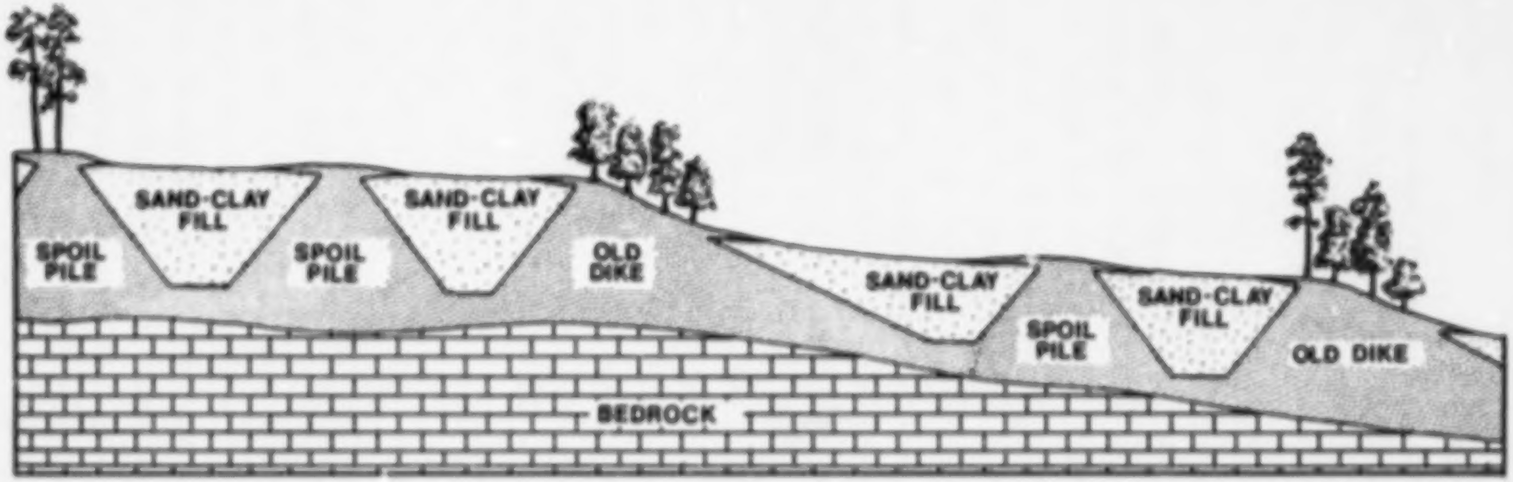


FIGURE 2-36. CROSS-SECTIONAL VIEW OF ADJOINING SAND-CLAY MIX RECLAMATION AREAS.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

2.7.1.1.2 Clay Settling Area

When mining is complete, only one conventional clay settlng area (Settling Area II, covering 583 acres) will remain. By the end of mining, this area will have been filled with clays to about 35 ft above natural ground level.

The crust development technique will be used to reclaim this settling area. When the area is deactivated, surface water will be drawn off through the in-place spillways and a perimeter ditch will be dug to establish initial drainage. As conditions permit, internal drainage ditches will be installed with specialized equipment, such as ditching plows pulled by low-ground pressure vehicles, to promote further surface drying. Within 4 to 5 years, the drying clays will subside considerably in the settling area. When a crust of sufficient stability to support machinery is formed, volunteer vegetation will be cleared from the area. The retaining dam and any protruding spoil piles will be pushed down to conform to slope requirements and to fill any depressions persisting within the area. There are no further plans to cover the clays with overburden since the clays are very fertile and when properly managed, can be very productive agricultural soils. All spillways will be removed and final drainage established through inter-spoil swales. The area will then be revegetated with forage species to complete reclamation. A period of 10 years has been allowed to complete reclamation of this area.

2.7.1.1.3 Sand Tailings Fill

As shown in Figure 2-6, two small mined areas covering a total of 104 acres will be backfilled with tailings sand. Sand tailings will be hydraulically transported from the flotation plant to the landfill sites. The previously mined cuts will be filled to approximately natural grade, and overburden from the protruding spoils will be graded over the fill to an average depth of approximately 2 ft. The spoil cap will provide the necessary soil fertility to support a good vegetative cover. Tailings fill consolidates rapidly, and reclamation of these areas should proceed at a rapid pace. After filling these areas with sand tailings, 2 years has been allotted to complete reclamation by grading of spoils and revegetation with forest species.

2.7.1.1.4 Lake Areas

The reclamation plan includes the creation of lakes in three areas shown in Figure 2-37. These consist of the clear water pool at the beneficiation plant, the drainage system left for Hickory Creek, and the depressions left as a result of the last 2 years of mining. These are described in more detail in the following paragraphs.

Clear Water Pool. The pit created during the first year of operation will serve as the plant clear water pool throughout the remaining life of the mine. In mining this area, spoiling patterns will be utilized that maximize the amount of volume available for below-grade water storage. Initial water depths in the lake will average around 30 ft; but over the 20-year life of the mine, sedimentation from turbid water in the plant water system will reduce the average depth somewhat. When mining is complete, the water level in the lake will be drawn down and spoils from the margins of the lake graded into the void to conform to slope requirements. This will form a littoral zone around the lake and result in an average depth not exceeding 15 ft.

Hickory Creek. Mining in the present Hickory Creek channel in years 13 and 14 will be done so as to create a lake system through which Hickory Creek will be rerouted. As shown in Figure 2-38, the upper portion of this 140-acre area will consist of a series of finger lakes which form a meandering channel for the creek. The lower portion of the lake system will consist of an open lake about 600 ft wide and 3000 ft long created by double spoiling the parallel mine cuts adjacent to this area. The lake system will intercept the undisturbed portion of the Hickory Creek channel at an elevation of approximately 65 ft and serve as the area's outfall into the natural floodplain at this point, thus establishing the water level in the entire lake system. Figure 2-39 provides a cross-sectional view of the water and land surfaces for the lake system.

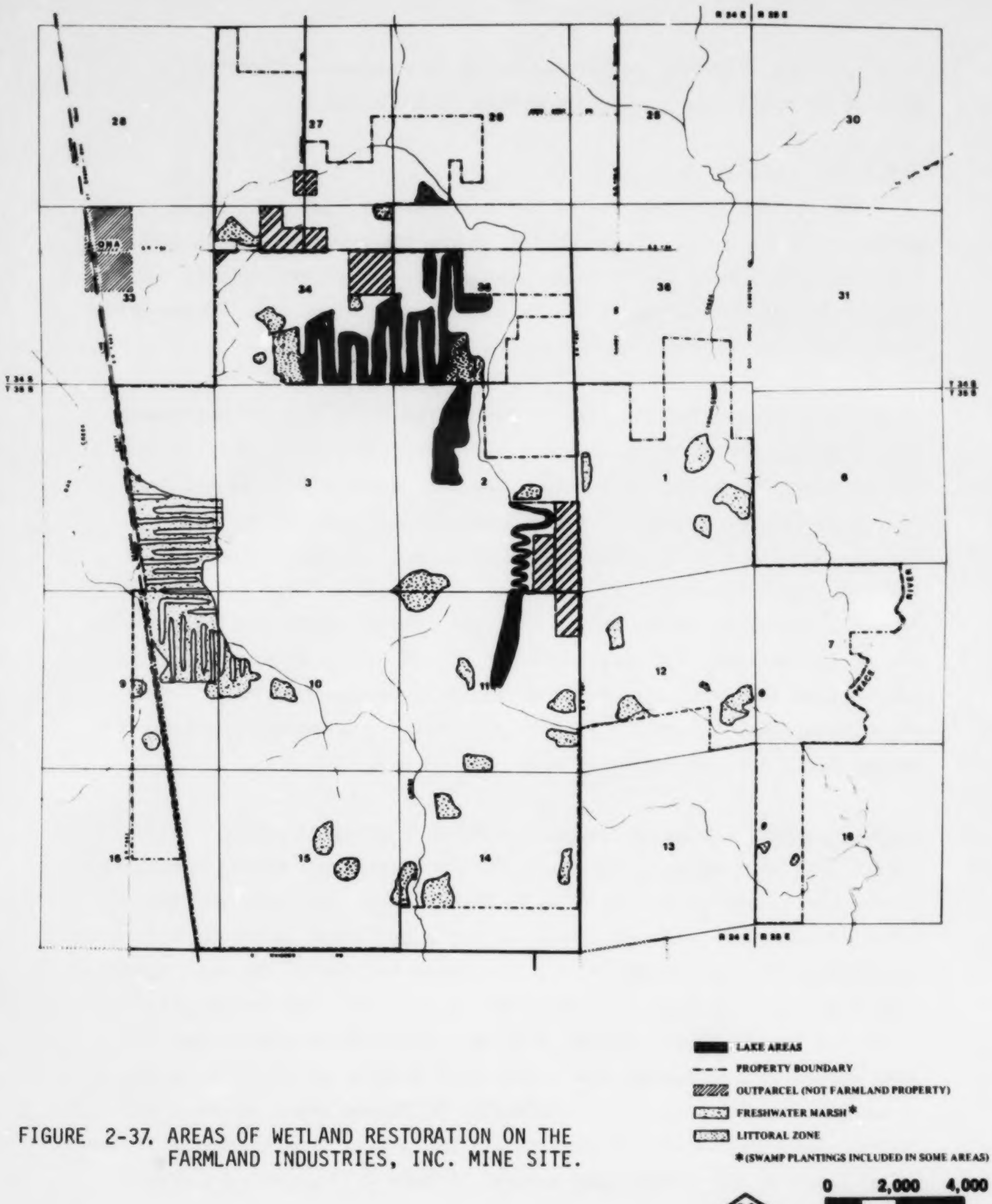


FIGURE 2-37. AREAS OF WETLAND RESTORATION ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

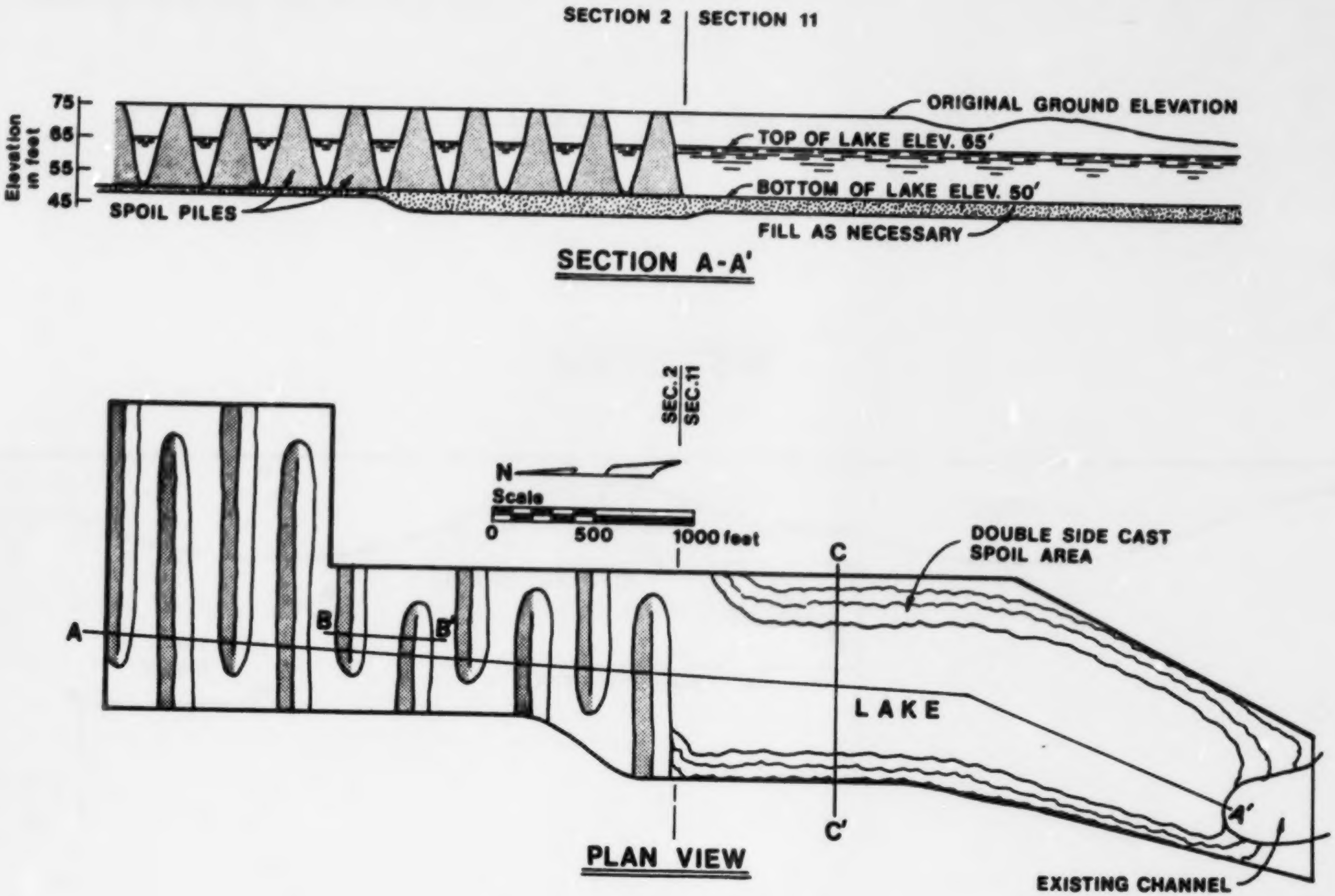


FIGURE 2-38. PHYSICAL CHARACTERISTICS OF THE LAKE SYSTEM TO BE CREATED BY RECLAMATION IN SECTIONS 2 AND 11, T35S, R24E OF THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

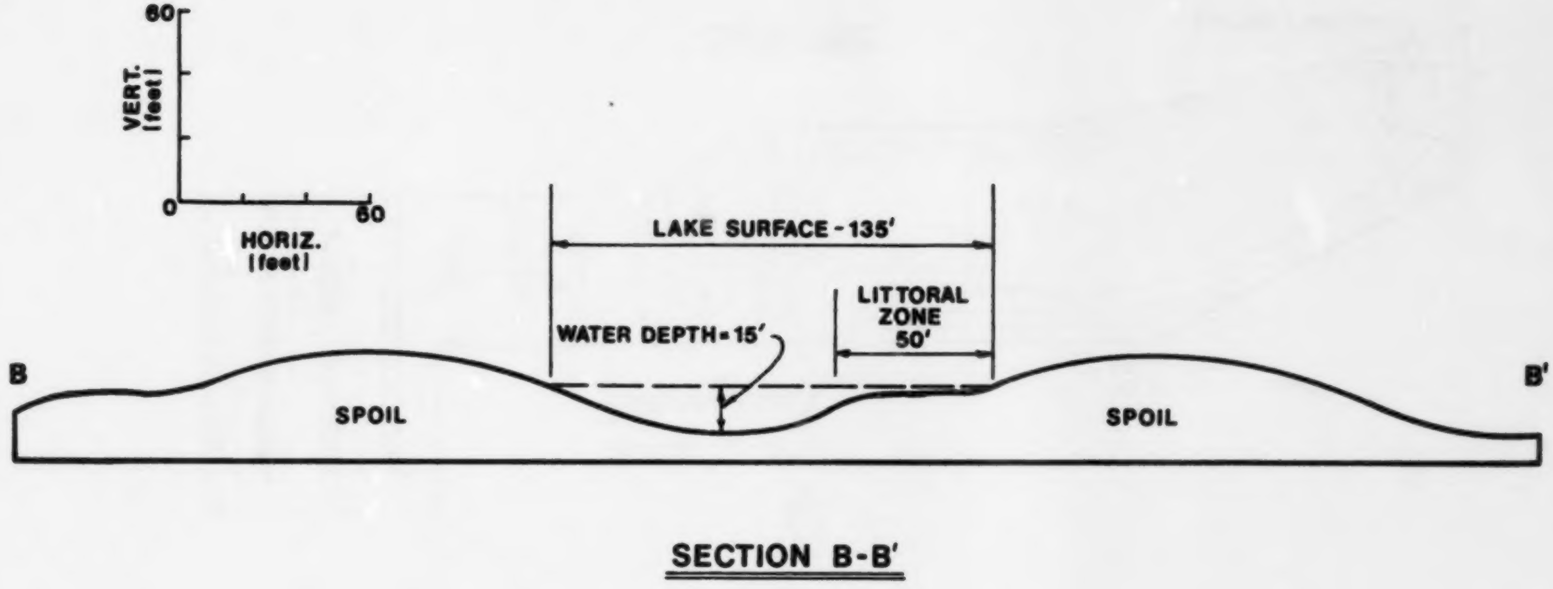


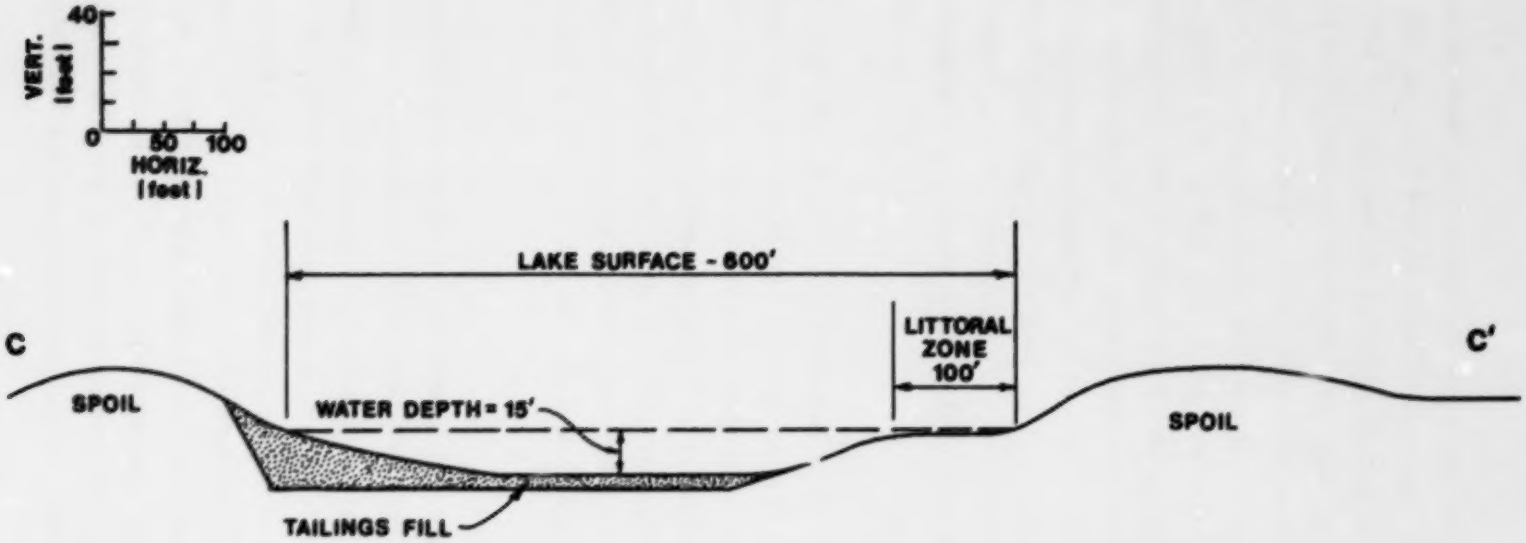
FIGURE 2-39. PHYSICAL DESIGN CONCEPTS FOR FINGER LAKE RECLAMATION AREA IN SECTION 2, T35S, R24E, OF THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

During reclamation of these lake areas, overburden from the spoils in the finger lake portion of the area will be graded into the mine cuts to (1) conform to slope requirements; (2) fill in the cuts to establish a maximum water depth of 15 ft; and (3) form a 50-ft wide littoral zone on one side of the lake as shown in Figure 2-39. In the open water lake in the lower portion of the area, the double spoil piles on the east side will be graded into the mine cut to form a 100-ft wide littoral zone approximately 1-3 ft deep as shown in Figure 2-40. On the west side of the mine cut, only a single spoil pile will be available to provide overburden fill for the mine cut. Tailings sand will, therefore, be used to supplement the fill on this side of the mine cut in order to establish a 12 to 1 slope out to a depth of 15 ft. When reclamation is complete, the area will be approximately equally divided between water and land surface.

Since the mining of this area includes the channel and floodplain of Hickory Creek, mining and reclamation will be completed as rapidly as possible. Mining of the area is planned to take place over a period of slightly over 2 years, beginning in year 12 and ending early in year 14. Physical and revegetative restoration of the area will require a period of 2 years before the creek is rerouted through the system. The period of actual downstream flow disruption will, therefore, have been kept to slightly over 4 years.

Land and Lakes Area. The land and lakes area to be created during the last 2 years of mining will be a 368-acre area previously occupied by Settling Area I. Double spoiling patterns will be utilized in the mining of this area in order to create a land and lakes area. Topography in the area is such that inflow to the lakes will be from the northwest, with lake outfalls potentially located in both the southwest and southeast corners--so that they could discharge to a tributary of Oak Creek or to Hickory Creek, respectively. As shown in Figure 2-41, extensive littoral zones will be created by grading the overburden in the vicinity of these outfalls. Weirs will establish and maintain the lake outfall levels.



SECTION C-C'

FIGURE 2-40. PHYSICAL DESIGN CONCEPTS FOR THE OPEN LAKE RECLAMATION AREA IN SECTION 11, T35S, R24E, OF THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

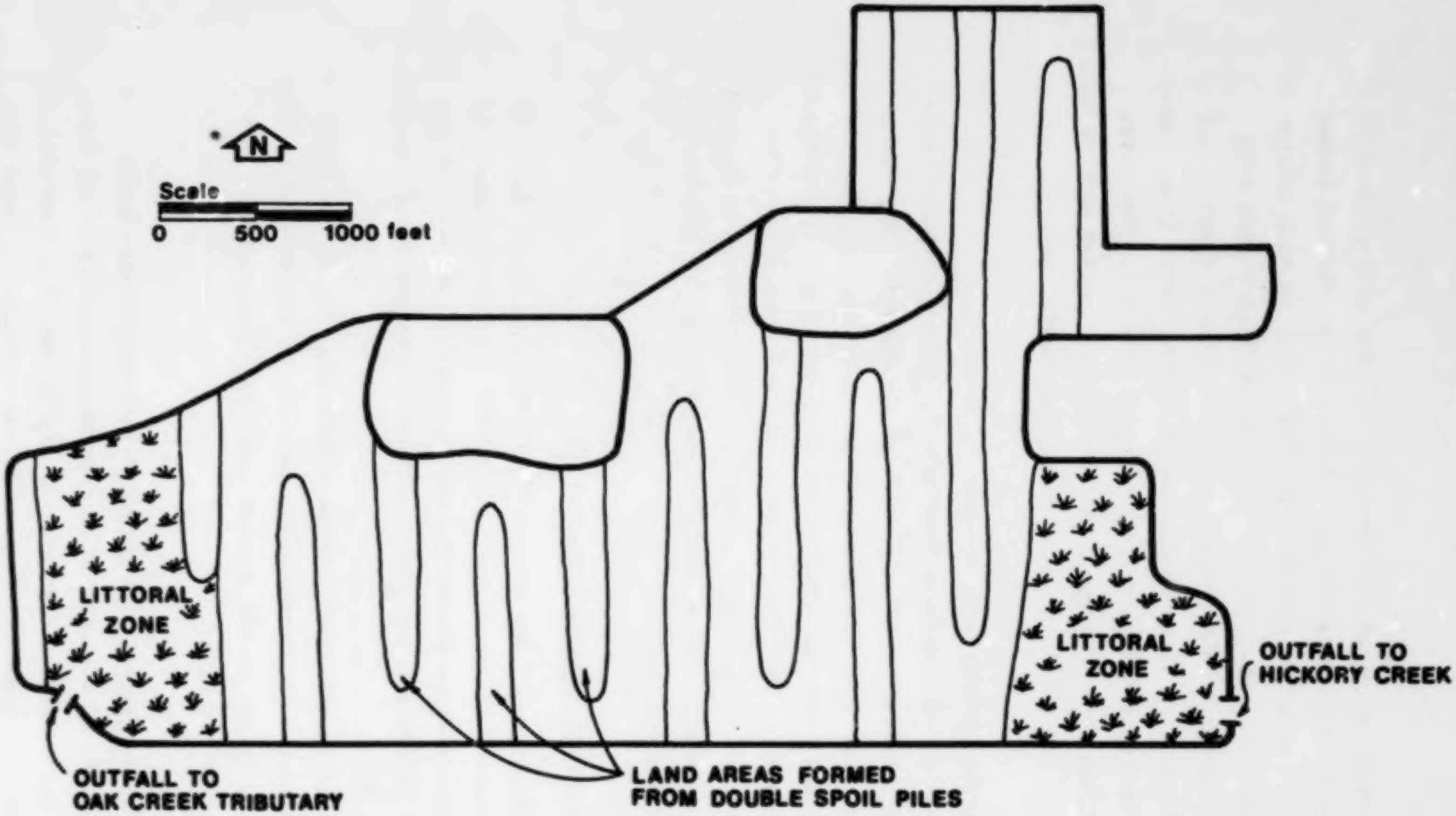

N
Scale
0
500
1000 feet
LITTORAL ZONE
LITTORAL ZONE
OUTFALL TO HICKORY CREEK
OUTFALL TO OAK CREEK TRIBUTARY
LAND AREAS FORMED FROM DOUBLE SPOIL PILES

FIGURE 2-41. PHYSICAL CHARACTERISTICS OF THE LARGE LAND AND LAKE AREA IN SECTIONS 34 AND 35, T34S, R24E, OF THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

All other spoil piles in this area will be graded into the mine cuts to conform to slope requirements. Mining depths and the groundwater table in the area are such that grading of spoils will achieve a maximum water depth of about 15 ft. Reclamation in this area will result in the creation of about equal amounts of land and water, and be completed within 3 years after completion of mining. Land areas (about 70 acres) will be planted in trees, the species used being dependent upon the prevailing soil drainage characteristics. Species such as bald cypress and black gum will be planted along the waters edge.

2.7.1.1.5 Disturbed Natural Ground Area

When mining is complete, the beneficiation plant, entrance railroad, and other ancillary facilities will be dismantled. Only facilities such as storage sheds and the plant entrance road will be retained if it is determined that they will either be moved to new mine sites or sold to scrap dealers. Materials such as concrete foundations that cannot be salvaged will be used as landfill. The disturbed sites will be graded, if necessary, to conform to slope requirements and revegetated with forage species.

2.7.1.2 Environmental Considerations

Environmental Advantages. The post-reclamation land area in agrarian use should be similar to (or greater than) that found at present. In addition, post-reclamation elevations and topography over much of the site should not differ greatly from premining elevations and topography.

Sand-clay mixing will also provide advantages in that the mixed snad-clay soils should be agronomically superior to either sand or clay alone. Radiation levels should also be less than those normally encountered in clay soils alone.

Environmental Disadvantages. The proposed reclamation plan would convert the majority of the site to an improved pasture/cropland type. This type will not support a diversity of floral and faunal species. The post-reclamation extent of the pine flatwoods/palmetto range type represents only 37 percent of the premining extent of this type. Species affected by loss of this habitat would include the Eastern indigo snake, a species considered "threatened" by the U.S. Department of Interior.

2.7.2 CONVENTIONAL RECLAMATION

2.7.2.1 General Description

Conventional reclamation is reclamation associated with the separate disposal of sand and clay wastes (i.e., conventional sand and clay waste disposal). Reclamation would consist of allowing a crust to form over the more than 2500 acres of impounded clays and seeding these areas with forage species, and creating extensive land and lakes areas in those areas of the site not covered with impounded clays. The revegetation of these areas would likely consist of forage species plantings on most land areas, with forest tree plantings along the edges of the lakes.

2.7.2.2 Environmental Considerations

Environmental Advantages. Conventional reclamation would result in the creation of more lake habitat than will result from Farmland's proposed reclamation plan. The techniques used for conventional reclamation have been tested by the industry over the years so that this plan is also operationally more proven than sand-clay mix reclamation. Areas not covered with impounded clays would consist of reformed overburden and sand tailings which can be worked relatively easily.

Environmental Disadvantages. Conventional reclamation would result in the creation of about 2500 acres of impounded clays. Following crust formation, this acreage would be suitable for rather limited use as pasture. The waste clays which would form the "soil" of these areas would also have radiological characteristics which would be less desirable than a mixture of waste sand and clay. Radium-226 analysis of samples from the Farmland site indicates that concentrations in the waste clays will be on the order to 5-12 pCi/g, while the projected concentration of sand-clay mix (at 2.5:1) is on the order to 3-4 pCi/g. Overburden samples from the Farmland site were also found to contain radium-226 concentrations above those of the projected sand-clay mix (ranging from 3 to 32 pCi/g).

2.7.3 NATURAL MINE CUT RECLAMATION

2.7.3.1 General Description

Natural mine cut reclamation would amount to leaving mined-out areas in windrows, with sand-clay mix deposited between windrows. Mined areas would be allowed to revegetate naturally, as has been the case in many of the older central Florida mines. The resultant use of the mined-out land would be largely for fish and wildlife habitat, with some pastureland.

2.7.3.2 Environmental Considerations

Environmental Advantages. Since grading of the site would not be required for natural mine cut reclamation, energy (fuel) savings would be realized and air emissions (from heavy equipment) would be reduced.

In addition, the habitats which would develop as the mined areas revegetated would be utilized by a variety of wildlife.

Environmental Disadvantages. Post-reclamation land use of the site would result in less agricultural productivity than is currently available. Persons traversing the unreclaimed site may also unknowingly walk over unstable, wet mine cuts--which would be dangerous.

2.7.4 SUMMARY COMPARISON - RECLAMATION

The reclamation plan proposed by Farmland is designed to provide for the restoration of both agricultural and ecological productivity. Both conventional reclamation and natural mine cut reclamation fail to attain this balance--conventional reclamation favoring agricultural use and natural mine cut reclamation favoring wildlife use and energy savings. Therefore, Farmland's proposed reclamation plan is considered to be the environmentally preferable alternative.

2.8 MITIGATION MEASURES

This section presents mitigation measures not already included in the proposed action or alternatives. These measures were developed from inputs received from preparers of the various sections of the EIS.

2.8.1 GEOLOGY AND SOILS

Farmland's proposed mining method involves the casting of overburden the shortest distance possible, generally into an arc-shaped pile in the mined-out pit. The resulting profile is that of relatively low piles requiring less than a full swing of the dragline bucket. If overburden were piled higher by increasing the casting distance, 11 percent more below ground volume would be available for clay disposal. This would amount to a 4 ft lowering of the above ground profile of the proposed Settling Area II (from 35 ft to 31 ft).

2.8.2 RADIATION

Farmland proposes to use "conventional spoiling" in the mining of phosphate rock. This mining method involves placement of overburden in piles such that the last material removed from above the matrix (where radioactive materials in the overburden are usually at their highest) is deposited on top of the spoils pile. A technique called "toe spoiling" has recently been introduced, whereby overburden from near the interface with the matrix is placed at the toe of the pile and covered with overburden from upper strata. Use of toe spoiling would reduce the radioactivity of the reclaimed surface soils.

Based on the predicted radioactivity of the reclaimed sand-clay mix soils, gamma exposure levels are expected to meet or only slightly exceed the 10 µR/hr interim recommendation for gamma exposure levels at new structure sites on Florida phosphate lands (EPA 1976). However, if a 6 in. layer of low activity soil were placed over the reclaimed surface, the soil component of the gamma radiation would be reduced by more than a factor of 2.

Placement of 10 to 15 ft of clean overburden over Clay Setting Area II, the only such area which will remain after mining is complete, would reduce radiation emissions to about 3 percent of that which will be emitted from this area if uncovered.

2.8.3 HYDROLOGY

Farmland proposes to use Surficial Aquifer water for pump seal lubrication. If treated mine water were used for this purpose, the withdrawals from the Surficial Aquifer would be decreased by 250 gpm (.36 mgd).

Farmland proposes to mine over 1 mile of Hickory Creek's streambed while its flow is diverted to Troublesome Creek, while about 4200 ft of streambed below the area to be mined will be preserved. However, this preserved area will be deprived of its normal flow when the upper area is mined. If the flow were diverted around the active mine area into the lower preserved section (rather than to Troublesome Creek), the impact on the preserved section would be lessened.

Farmland proposes to mine adjacent to the lower preserved portion of Hickory Creek discussed above. This area will be surrounded by active mine cuts in years 12 and 13. The loss of baseflow resulting from Surficial Aquifer dewatering would be minimized if open mine cuts were present on only one side of the Hickory streambed at a given time.

2.8.4 WATER QUALITY

No provision is made to monitor the quality of the Surficial Aquifer in the area of sand-clay mix disposal areas. If observation wells were installed in the vicinity of these areas, early detection of any contamination would be possible and corrective measures could be taken.

2.8.5 TERRESTRIAL ECOLOGY

Farmland proposes to reclaim the mine site such that forested habitats (both reclaimed and preserved) will in some cases be separated by unbroken areas of improved pasture. The impacts on terrestrial ecology could be reduced if the reclamation plan provided for the establishment of forested corridors between such areas on the reclaimed mine site.

Farmland proposes to reclaim the mined areas through which Hickory Creek currently flows as a lake system which will discharge to the establishment of a littoral zone at the downstream end. This littoral zone should be at least 500 ft wide and of a depth suitable for the growth of emergent vegetation.

The indigo snake occupies a variety of habitats throughout its range--from dry, sand pine-oak communities to moist tropical hammocks--but is most suited to mesic environments. Although it commonly occurs in sandhills and other xeric habitats, its survival in such areas is possible only because gopher tortoise burrows or other subterranean cavities are available for shelter. In the Hardee County region it has been recorded most often from live oak hammocks, old fields, pine flatwoods, and oak-pine sandhills. The proposed project will destroy some wetland, oak hammocks and dry flatwoods habitats, thus reducing the onsite habitat available to the indigo snake. The upland habitats created as the result of the proposed reclamation plan will generally not be suitable for the indigo snake (Layne, et al. 1977). Consequently, the long-term effect of Farmland's proposed reclamation plan on the indigo snake will be a reduction in available upland habitat and possible reduction in the species' population in the site region. However, the impact of the Farmland project on this species might be lessened if mitigative measures were undertaken by Farmland. A list of such measures was developed following communications with experts on the indigo snake (Mohler 1980; Palmer 1980; Speake 1980). It should be noted, however, that the effectiveness of such measures in mitigating the impacts of a mining project is unknown. The suggested measures are as follows:

- Inform workers of the importance of the indigo snake and request that they not kill individuals they encounter on the site.
- Develop a program whereby indigo snakes encountered in the work area are captured for relocation to other areas of suitable habitat in the site region.
- Establish windrows similar to those created in clear cutting operations. The cover created normally results in an increase in rodent populations and is thus beneficial to predators such as the indigo snake.
- Maintain selected undisturbed areas in early stages of vegetative succession using the technique of controlled burning. Such areas appear to be favored by the indigo snake.
- Protect the gopher tortoise population in the site area. The presence of subterranean burrows such as those created by the gopher tortoise is necessary for survival of the indigo snake in dry uplands. Any measure that increases the gopher tortoise population should be beneficial to the indigo snake.

Farmland's proposed reclamation plan includes the restoration of 398 acres of wetlands. However, this amounts to only 77 percent of the Category 2 (514 acres) wetlands which will be destroyed by the proposed mine plan. If 116 additional acres of wetlands were created during reclamation, which Farmland (1979) indicates is possible, the Category 2 wetland acreage lost would equal that to be restored.

2.8.6 AQUATIC ECOLOGY

Farmland's proposed action will result in a reduction of streamflow in lower Hickory Creek. This reduction will have adverse effects on aquatic biota occurring there. Several measures which would lessen the flow reduction in this portion of the stream are described under Section 2.8.3, above. These would also serve to mitigate impacts on the aquatic biota associated with this area.

2.8.7 SOCIOECONOMICS

It is outside the EPA's ability to require that the following mitigation measures be made part of the project. They are, however, provided as actions which Farmland could undertake at its discretion to mitigate adverse socioeconomic effects.

Because a large percentage of the work force involved with construction and operation of the proposed mine will commute from neighboring counties, traffic levels on local roads will increase. In order to minimize the effects of this increase, Farmland could encourage and coordinate the formation of employee car pools.

Hardee County has relatively high unemployment for the region and has had difficulty providing employment opportunities for local youth entering the work force. While Farmland will be providing employment to Hardee County residents, this benefit could be increased through their participation in local vocational programs. Advance information concerning occupational and skill needs could be provided to local vocational schools so that individuals could obtain the skills that Farmland will be seeking in the future.

2.9 THE NO ACTION ALTERNATIVE

The no action alternative by EPA would be the denial of an NPDES permit for the proposed project. The effect of permit denial would be to precipitate one of three possible reactions on the part of Farmland: (1) termination of their proposed project; (2) indefinite postponement of the proposed project; or (3) restructuring of the project to achieve zero discharge, for which no NPDES permit would be required.

2.9.1 TERMINATION OF THE PROJECT

Termination of the planned project would allow the existing environment to remain as described in Section 3.0, and the gradual socioeconomic and environmental trends would continue as at present. Specifically, the meteorologic and noise characteristics are expected to remain as described in Section 3.1.1. However, air quality changes may occur due to emissions from new sources permitted in the region in the coming years or because of changes in fuels used at existing sources. The geologic features of the site would remain as described in Section 3.2.1, and the existing soils would continue to support the established vegetation, grazing lands, and limited agricultural crop production. Since the proposed project would cause intermixing of the nutrient deficient surface soils with the relatively nutrient-rich deeper soils and the placement of phosphate bearing clays at surface levels, the long-term productivity of the site would be expected to increase. In the absence of the project, this effect would not occur.

If the project were terminated, the Farmland site would remain in its present radiological state, leaving outdoor gamma radiation and Rn-222 flex at lower levels than would be the case after reclamation. Accordingly, any potential adverse effects that might result from the redistribution of subsurface radioactivity could not occur.

Termination of the project would also mean no appreciable changes in the existing quantities of groundwater. The seasonal pumping of the Floridan Aquifer by irrigation wells with the resultant drawdowns would continue, while the hydrologic characteristics of the Surficial Aquifer and baseflow to local surface waters would be expected to remain as at present. Groundwater quality under this no action alternative will depend on future land uses. If land use patterns in the vicinity of the site continue much as they are, then groundwater quality should also remain essentially as it is today.

Under the no action alternative of project termination, no appreciable changes in the existing surface water quantity are anticipated. Surface water quality will depend on future land use. If land use patterns in the immediate area remain fairly constant over the next few decades, surface water quality should remain much as it is today. If other phosphate mining and processing projects are permitted, selected streams may show increases in TDS, sulfate, phosphate, nitrogen, and fluorides. Slight increases in radiological concentrations may also be expected.

If the proposed project is terminated, the aquatic environment with its alternating hydroperiod and tolerant organisms will remain as it now exists (Section 3.6.1); however, succession of marshes into bayheads, etc., will in time modify some aquatic habitats. The terrestrial ecology of the Farmland site should remain as now (Section 3.7.1), with most of the site continuing to be used for agricultural purposes including citrus groves, truck crops, and livestock grazing.

The no action alternative of project termination would have socioeconomic impacts on Hardee County and the central Florida region. The generation of jobs with comparatively high income, anticipated under the planned project, would not occur. Neither would the population influx associated with relocating direct and indirect employment take place. The $900,000 annual revenue, generated by the proposed project through ad valorem taxation and redistribution of sales tax collected in Hardee County, would not materialize. Present land uses would likely continue, but it is probable that the property value of the site would drop (relative to the value for phosphate mineable land).

This no action alternative would make the demand for transportation facility capital improvements, such as paving the Fort Green-Ona Road, less urgent or unnecessary. It would eliminate an additional demand, posed by the project, on an already inadequate housing situation and on fire protection, police and medical services. While project termination would prevent the expected increase in Hardee County expenditures to provide such services, the revenue generated from the project is expected to exceed expenditures. Termination of the project would also preclude the generation of about $2.4 million a year in severance tax, of which 50 to 75 percent would go to the State General Revenue Fund and the remainder to the Land Reclamation Trust Fund and the Florida Institute of Phosphate Research.

Termination of the project would mean that no known or unknown archaeological or historic sites would be destroyed by the proposed mining. The total of 10 historic sites and 19 archaeological sites recorded for the site would likely remain undisturbed. However, all of the known archaeological sites are reported as disturbed lithic scatter sites and none of the historic sites is considered historically significant.

The proposed construction, operation, and reclamation of the mine site would create a variety of moderate to strong negative visual impacts. Without the project these would not occur.

Lastly, the no action alternative of no mining project on the Farmland site would mean the approximately 40 million tons of phosphate matrix would not be recovered in the short term (the next 20 years). This non-renewable resource would accordingly be unavailable for fertilizer manufacture, and Farmland's 1/2 million farmer-owners would be subject to increased uncertainty in obtaining a supply of fertilizer to meet their agricultural needs. Project termination would also result in a loss of considerable project investment by the corporation.

While the 40 million tons of phosphate resource would not be recovered in the short term, they would remain as unmined phosphate reserves. As discussed further in Section 5.1, the possible depletion of U.S. phosphate reserved have become a matter of concern. The U.S.

Bureau of Mines has predicted that high grade phosphate reserves will be exhausted by 2010. With depletion of reserves and other restrictions reducing available supplies of phosphate rock, fertilizer supplies may become strategically important to the U.S. in the next century. Therefore, denial of the permit could mean that the site's phosphate would be conserved and retained as a national resource, while simultaneously appreciating in value to Farmland.

2.9.2 POSTPONEMENT OF THE PROJECT

If EPA were to deny Farmland's NPDES permit application, the project might be postponed for an indefinite period of time and then successfully pursued by either Farmland or another mining company. This might be expected to occur when, as described above, high grade phosphate reserves are depleted and the resource retained on the Farmland site becomes extremely valuable strategically as well as economically. An adverse effect resulting from postponement of the project would be the delay of socioeconomic benefits to the county and state in the form of job opportunities, payroll and taxes. Farmland would be adversely affected in that its capital investment could not be realized for an indefinite time.

On the other hand, important benefits could result from project postponement. Experimentation and research are ongoing in the areas of phosphate recovery efficiency, waste sand and clay disposal, reclamation, and wetlands restoration and creation. Technological advances could occur in these areas during the period of postponement which would allow a much improved overall project.

2.9.3 ACHIEVING A ZERO DISCHARGE

If EPA denies the NPDES permit, Farmland could still execute a mining project provided the project could be performed with zero discharge to surface waters. Under zero discharge conditions, neither an NPDES permit nor an Environmental Impact Statement would be required.

Achieving zero discharge would be extremely difficult, if not impossible, and would most likely require significantly increased surface impoundment for storage of water. The problems occurring with increased surface impoundment would include increased dike heights, probable infringement on presently designated preserved areas, a less desirable reclamation plan, and more limited post-reclamation land use potential.

It should be noted that although the EIS process would no longer be involved in scrutinizing these changes (should zero discharge be achieved), nevertheless the applicant's Development Order approved through the Florida DRI process, would have to be modified and any changes approved by the county and state.

2.10 EPA'S PREFERRED ALTERNATIVES, MITIGATING MEASURES, AND RECOMMENDED ACTION

The environmentally preferable alternative, EPA's preferred alternative, and Farmland's proposed action (including mitigating measure presented as part of the proposed action) all coincide with respect to the following project components.

Mining Method (dragline)
Matrix Processing (conventional)
Waste Sand and Clay Disposal (sand-clay mix)
Process Water Sources (groundwater withdrawal)
Water Management Plan (discharge to surface waters)
Reclamation (combination of sand-clay mix landfill, crust development on clay settling areas, sand tailings landfill, lakes construction and restoration of disturbed ground--included in this plan are preservation of 992 acres of wetlands and restoration of 398 acres of wetlands).

Regarding matrix transport, the environmentally preferable alternative identified in the EIS is conveyor transport; however, technical problems associated with this alternative make it infeasible at this time. Therefore, EPA considers matrix transport by the conventional slurry matrix method the only environmentally acceptable alternative capable of meeting the applicant's needs.

In addition to identifying the environmentally preferable alternatives, EPA's assessment has focused on developing mitigating measures, not already a part of the proposed action, which could minimize adverse impacts of the project. These are discussed in Section 2.8 of the EIS. EPA has determined that most of these measures should be incorporated into the proposed project. Specifically, EPA recommends that:

- Overburden be piled such that the volume available for below ground waste disposal is maximized.
- "Toe spoiling" be used to place leach zone material at depth in mined areas--reducing the radioactivity of reclaimed surface soils.
- Hickory Creek not be diverted to Troublesome Creek when the stream channel of the former is mined, but rather divert the flow to the preserved portion of Hickory Creek downstream of the mine area.
- Mining in the vicinity of lower Hickory Creek be scheduled such that open pits exist adjacent to only one side of the preserved portion at a given time.
- The acreage to be reclaimed as forest habitat be increased by planting additional areas of the mine site so as to provide corridors for wildlife movement between reclaimed and preserved areas.
- A littoral zone be established at the downstream end of the lake system proposed in the reclamation of the mined area through which Hickory Creek currently flows. This littoral area shall be at least 500 ft wide and at a depth suitable for the establishment of emergent vegetation, providing 7 to 10 acres of marsh community.
- The acreage to be reclaimed as freshwater marsh or swamp be increased by 116 acres so that the acreage of Category 2 wetlands lost by the mining operation is totally restored by reclamation.
- A program to reduce impacts on the indigo snake, a threatened species, which occurs on the site, be implemented (see Section 2.8.5).
- Monitoring of the quality of the Surficial Aquifer in the vicinity of sand-clay mix disposal areas be done through the life of the mine.

Mitigation measures not recommended by EPA are the capping of waste disposal areas with low activity overburden and the use of treated mine water to meet pump seal requirements. While environmental impacts might be reduced by the capping of waste disposal areas, this is considered impractical on the scale of the proposed mine--both for economic and technical reasons. The withdrawal of water from the Surficial Aquifer to supply pump seal requirements represents only 6 percent of the minimum groundwater withdrawal required for the project. In addition, water will be withdrawn (in most instances) from areas which will eventually be mined--totally destroying the Surficial Aquifer itself, at least in the short term. Therefore, the economic costs and technical difficulties which treatment of mine water would pose to Farmland are not considered justified.

In order to make its determination regarding the NPDES permit application for the Farmland project, EPA has developed a comparison between (1) Farmland's Proposed Action; (2) EPA's preferred alternatives and mitigating measures; and (3) the no action alternative of permit denial by EPA, which could lead to termination of the project, postponement of the project, or modification of the project such that a NPDES permit would not be required (i.e., achieve zero discharge). This analysis is presented in Table 2-2.

After careful evaluation of these alternatives, EPA's proposed action is to issue the NPDES permit to Farmland. The project authorized by the permit should be Farmland's proposed action, which is the sum of EPA's preferred alternatives; and shall incorporate all the mitigating measures identified as part of Farmland's proposed action (see Page 2-16) as well as all the mitigating measures recommended by EPA in this section.

2.11 REFERENCES

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Table 2-2. COMPARISON OF THE ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES.

Discipline	Farmland's Proposed Action	EPA'S Preferred Alternatives and Mitigating Measures	The No Action Alternative		
			Termination	Postponement	Achieve Zero Discharge
Air Quality, Meteorology, and Noise	Minor increases in fugitive dust emissions and emissions from internal combustion engines; minor emissions of volatile reagents; increased noise levels in the vicinity of operating equipment.	Same as Farmland's proposed action.	No change in meteorology & noise levels present; possible air quality changes from other sources.	Same as Farmland's proposed action.	Same as Farmland's proposed action.
Geology and Soils	Disruptions of the surface soils and overburden strata over the mine site; depletion of 40 million tons of phosphate rock resources; creation of a reclaimed soil material which should be superior to existing soils.	Same as Farmland's proposed action, except that the height of the remaining waste clay impoundment could be reduced by about 4 feet by piling overburden to greater heights.	No change in geology; no change in site soils (i.e., increased productivity); preservation of 40 million tons of phosphate rock reserves.	Possible increased phosphate recovery and more effective sand-clay mix disposal, reclamation, and wetlands restoration.	Increased dike heights, and water storage capacity; probable infringement on preserved areas; less desirable reclamation plan.
Radiation	Disruption of the natural distribution of radioactive material within the overburden and phosphate matrix; increased radiation levels from reclaimed surfaces.	Same as Farmland's proposed action, except that reclaimed surface soils would contain less radioactive material because of toe spoiling.	No change in radiation characteristics of the site.	Same as Farmland's proposed action.	Probable increase in area covered with waste clays--the reclaimed material having the highest radioactivity levels.
Groundwater	Withdrawal of groundwater from the Floridan Aquifer at an average rate of 8.83 mgd; lowering of Surficial Aquifer in the vicinity of active mine pits; possible local contamination of Surficial Aquifer adjacent to sand-clay mix disposal areas.	Same as Farmland's proposed action.	No change in existing groundwater quantity and quality.	Possible reduction in groundwater withdrawals because of more effective dewatering of waste materials.	Same as Farmland's proposed action.
Surface Water	Disruption of surface water flows from the mine site; minor reduction in flows following reclamation; degradation of water quality due to discharges from the mine water system.	Same as Farmland's proposed action, except that flow would be maintained in lower Hickory Creek, instead of increasing flow in Troublesome Creek; and there would be reduced loss of baseflow to Hickory Creek in years 12-13.	No change in surface water quantity; surface water quality would be dependent upon future land uses in the site area.	Same as Farmland's proposed action.	Elimination of surface water quality impacts resulting from discharge from mine water system; increased probability of dike failure impacts.
Aquatic Ecology	Destruction of aquatic habitats on the mine site; aquatic habitat modifications due to reduced surface water flows and addition of contaminants to creeks flowing from the site.	Same as Farmland's proposed action, except that the impacts on aquatic biota in Hickory Creek will be lessened by the continuation of flow through its preserved lower portion.	No change in existing aquatic ecology.	Same as Farmland's proposed action.	Elimination of habitat modification resulting from discharge from mine water system; increased probability of dike failure impacts.
Terrestrial Ecology	Destruction of terrestrial habitats and loss of individuals of some species on the mine site; creation of modified habitats following reclamation.	Same as Farmland's proposed action, except that the wildlife habitat on the reclaimed mine site will be more extensive (both marsh and forest).	No change in existing terrestrial ecology.	Possibly more effective reclamation and wetlands restoration.	Probable creation of increased reclaimed land areas (waste clays) of limited use (e.g., pasture).
Socioeconomics	Generation of jobs with comparatively high incomes; ad valorem and sales tax revenue for Hardee County; severence tax revenue for the state, Land Reclamation Trust Fund, and Florida Institute of Phosphate Research; some population influx to Hardee County; increased demands for housing, transportation, fire protection, police, and medical services.	Same as Farmland's proposed action.	Loss of jobs which would be generated by the project; loss of tax revenue for Hardee County and the State; less demand for transportation, housing, fire protection, police and medical services; continuation of phosphate rock market uncertainties for Farmland and a loss of their investment.	Continuation of phosphate rock market uncertainties for Farmland and potential increased project costs; possible improvement in supply/demand for housing in Hardee County.	Same as Farmland's proposed action.

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3.0

THE AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

The proposed mining and processing of phosphate rock at the Farmland site and subsequent reclamation of disturbed land will result in impacts on the existing environment. The affected environment and environmental consequences of the alternative methods of accomplishing the identified project goals are presented in this section. The discussion is arranged by environmental discipline and project component (e.g., mining, matrix transport) so that the alternative methods for any given component can be examined to an equal degree, thus providing a basis for comparison. Only those project components having impacts relating to a given discipline are discussed under the discipline headings. The first alternative discussed under each component is the no action alternative, followed by the impacts of Farmland's proposed action and other relevant alternatives.

Under the no action alternative, it is assumed that Farmland would not proceed with the construction/operation of the proposed facilities, and that the site would remain as is for the foreseeable future. It should be noted, however, that the site's phosphate reserves represent a value which may be sought through another proposed action (by Farmland or another phosphate company) at some future date.

The action alternatives are comprised of various methods by which Farmland's project goals could be met. These methods are grouped by project components as follows:

Project Component	Alternative Methods
Mining	Dragline Mining Dredge Mining Bucketwheel Mining
Matrix Transport	Slurry Transport Conveyor Transport Truck Transport
Matrix Processing	Conventional Matrix Processing Dry Matrix Processing
Waste Sand and Clay Disposal	Sand-Clay Mixing Conventional Sand and Clay Disposal
Process Water Sources	Groundwater Withdrawal Surface Water Impoundment
Water Management Plan	Discharge into Surface Waters Use of Connector Wells
Reclamation Plan	Farmland's Proposed Reclamation Plan Conventional Reclamation Natural Mine Cut Reclamation

3.1 AIR QUALITY, METEOROLOGY, AND NOISE

3.1.1 THE AFFECTED ENVIRONMENT

3.1.1.1 Meteorology

The Farmland site is located in west central Florida, which has a semitropical climate. Weather conditions are greatly influenced by the area's latitude and by the relatively warm coastal waters surrounding the state. The project site is subject to annual variations in both temperature and precipitation; however, analysis of the data obtained from surrounding stations indicates that the area sustains two general seasonal patterns (winter and summer). Summers are hot and humid; extremely high temperatures are rare due to convective cloud activity and frequent afternoon thunderstorms. Winters are generally mild, with periodic invasions of cool to cold air from the north. Rainfall is abundant, averaging approximately 140 cm (55 inches) for the year. The heaviest rainfall occurs in June, July, August, and September. Very heavy rainfall amounts are associated with tropical storms and hurricanes which occasionally pass through the area during the late summer and fall months. The storms may also cause wind and water damage to crops and buildings. The following paragraphs provide a more detailed discussion of temperature, precipitation, humidity, wind, and other meteorological parameters characterizing local and regional climatic conditions.

Temperature. The average annual temperature is approximately 22.5°C (72 to 73°F). The monthly averages range from 16.5°C (62°F) in the winter (January) to 27.8°C (82°F) in the summer (August). Winters are pleasant and characterized by bright warm days and cool nights. Temperatures during the winter are seldom severe; however, major cold waves do overspread the area, occasionally bringing temperatures down to the twenties (°F). Temperatures of -6.1°C (21°F) were recorded at Wauchula during cold waves in December 1962 and January 1981. Frost conditions vary considerably between low and high ground locations. Although the total incidence of freezing temperature is low, a single occurrence lasting more than a few hours can severely damage crops. In a study conducted by Bradley (1974), 17 freezing occurrences were reported at Lakeland between 1931 and 1950. Forty-one occurrences were reported at Arcadia (13 miles southwest of the project site) during the same period. During the summer season the maximum temperature ranges between the high eighties and mid-nineties, while minimum temperatures usually drop to the low seventies (°F). The maximum temperature reported at Wauchula was 40°C (104°F), while a maximum of 38°C (101°F) was reported at both Tampa and Lakeland. Most afternoon temperatures are moderated by thundershowers; temperatures frequently plunge from the mid-nineties to the low seventies or high sixties (°F) in a matter of minutes during one of these thundershowers.

Precipitation. Rainfall in the Farmland site area is abundant, averaging 137 to 139 cm (54 to 55 inches). Seasonal variations are apparent from the data; the heaviest rainfall occurs during the months of June, July, August, and September, with an average of between 18 to 23 cm (7 to 9 inches) falling during these months. November and December, the driest months, average less than 5 cm (2 inches). Occasional tropical storms serve to increase the late summer and early fall amounts, but the frequency of these storms is low and they have little effect on the long-term average annual rainfall. Presented below are maximum precipitation amounts projected for the project site (point precipitation) for 24-hr periods and specific recurrence intervals computed using statistical procedures outlined by Hershfield (1961) and Miller (1964). These data appear to be consistent with available long-term data for the area.

	Recurrence Interval					
	1 yr	5 yrs	10 yrs	25 yrs	50 yrs	100 yrs
Maximum 24-hour Point Precipitation (in.)	4.0	6.5	7.8	8.9	9.0	11.0

It is important to note also that the annual average is a statistical summary of precipitation data collected over a period of 30 years or more. Considerable variations can occur from year-to-year or over an extended period of time. For example, during the period 1964 through 1975, precipitation appears to be generally below normal for the project area, with a 1- or 2-year exception (Mississippi Chemical Corporation 1976). Cyclic patterns and significant variations from the "normal" are evident from these data.

Humidity and Fog. As would be expected in an area of high rainfall and subtropical temperatures, central Florida's humidity also is moderate to high. The highest humidity usually occurs around dawn, with the lows occurring in the early afternoon. Associated with the humidity is the occurrence of ground fog, which is observed most often during the winter (Bradley 1974). Most heavy fog dissipates rapidly after sunrise and is gone before noon.

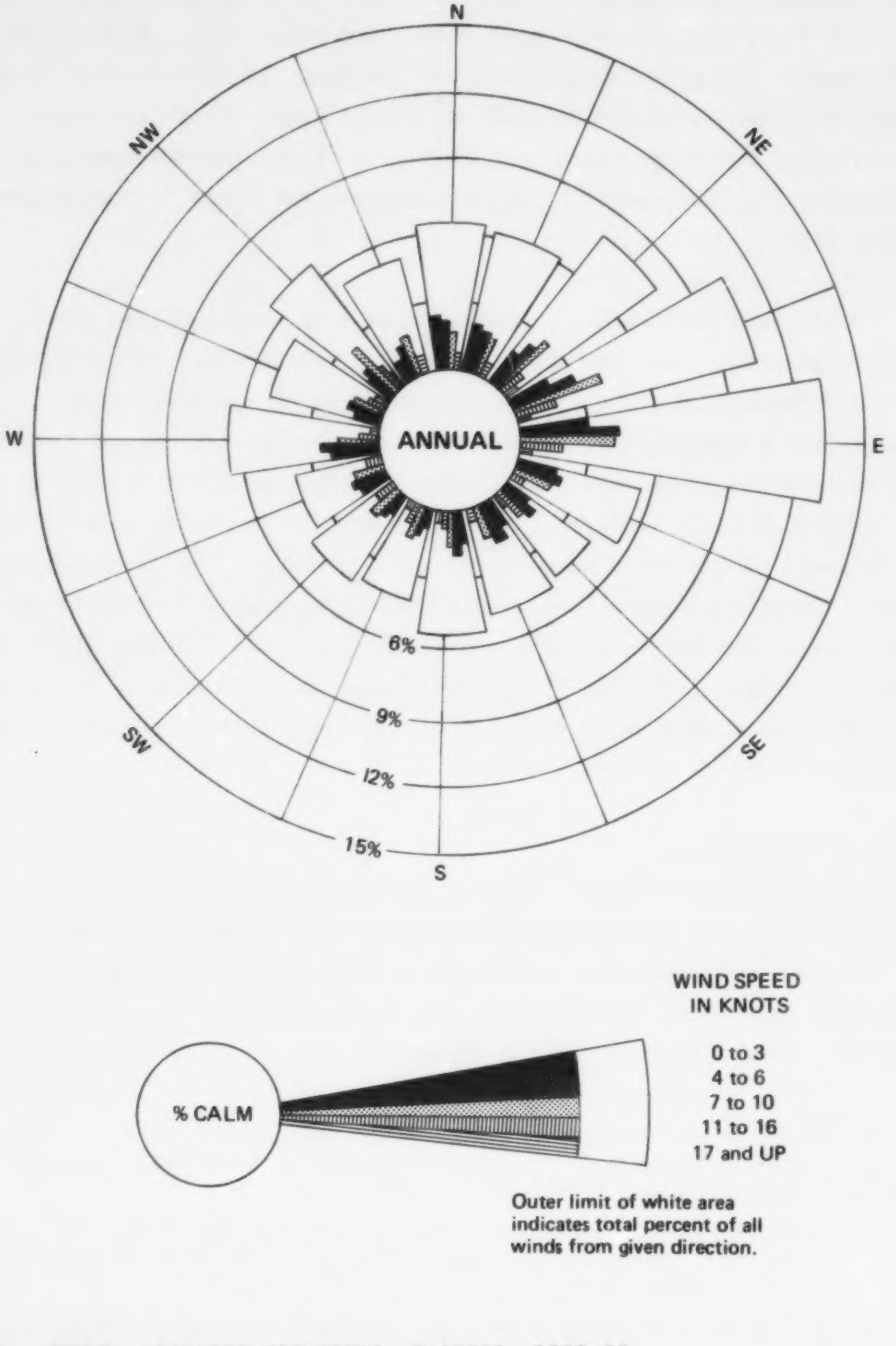
Wind Direction and Speed. Windspeeds at the Farmland site are moderate (i.e., 7 to 12 mph) in the cooler months and light (i.e., 0 to 4 mph) in the summer. The prevailing directions are from the NW and SE 45 degree segments. Tampa data (1960-1964) and onsite wind data do not differ excessively, but Tampa winds are slightly stronger and are more predominantly from the east. An annual windrose for Tampa is presented in Figure 3-1.

While data from nearby cities such as Tampa and Lakeland can be used to generally describe the wind speed/direction variation expected at the Farmland site, data have been presented by the IFAS of the University of Florida (IFAS 1980) which suggest that important data are not included in these data bases, specifically, the occurrence of low wind speeds (<2.3 miles/hr). These data are not available because the stall speed of the Tampa anemometer is 2.3 miles/hr. It is the National Weather Service's policy to code all winds less than 2.3 miles/hr as calm, and to ignore the direction of winds less than 2.3 miles/hr. The IFAS report indicates that it is these winds that would cause pollutants trapped by an inversion to drift slowly in the stable layer and accumulate over a relatively small area.

3.1.1.2 Air Quality

The major industrial sources of pollutants in the region are from electric utilities and the phosphate industry. Among the primary pollutants associated with the phosphate industry are SO_2, TSP, and insoluble fluorides. EPA (1978a) reports that these result from the following phosphate industry activities:

"- SO_2 originates primarily from the burning of sulfur containing fossil fuels and the manufacture of sulfuric acid from elemental sulfur (Pedco 1976a; EPA 1977).
- TSP is generated by fuel-burning, drying, grinding, and material transport, as well as by some stages of mining (Pedco 1975; 1976a, 1976b).
- Fluorides arise from various chemical processes, drying and calcining, fluoride removal for feed preparation, and gypsum and cooling-water ponds (ESE 1977a; Tessitore 1975; 1976)."



Outer limit of white area indicates total percent of all winds from given direction.

FIGURE 3-1. ANNUAL WINDROSE FOR TAMPA, FLORIDA; 1960-64.

SOURCE: WOODWARD–CLYDE CONSULTANTS, 1981

EPA (1978a) summarizes point and area sources emissions over a seven county area in west central Florida. From these data it is noted that Hillsborough point sources are dominated by the power industry, while Polk County point sources are dominated by the phosphate industry. Emission sources in Manatee County are low to moderate (with some utility and phosphate industry activity), while emission sources in the surrounding Counties of Charlotte, DeSoto, Hardee, and Sarasota are relatively insignificant. In the industrial counties (Polk and Hillsborough) point sources dominate; for the other five counties, area sources dominate.

The Farmland site is quite distant from existing sources and is well ventilated. Measured SO_2, total suspended particulate, and particulate fluoride ground-level concentrations at the Farmland site are presented in Table 3-1. The maximum concentrations of these pollutants measured at the Farmland site were 157 $\mu g/m^3$ (3-hr), 74 $\mu g/m^3$ (24-hr), and 0.40 $\mu g/m^3$, respectively.

3.1.1.3 Noise

Ambient noise levels were measured at six locations in the vicinity of the Farmland site in September 1979 and January 1980 (Woodward-Clyde Consultants 1981). From day and night A-weighted (Leq) sound levels determined for each location, day-night average sound levels (L_{dn}) were computed. The L_{dn} is the primary measure of a noise environment that affects a community over an entire 24-hr day. The highest L_{dn} value determined (73.8 db[A]) was from sounds associated with traffic on Highway 663 (south of the site) and nearby farming activities. Relatively high sound levels (70-71 db[A]) were also recorded along Route 64 east of Ona due to sounds from traffic and nearby residences. At locations distant from roads and residences, L_{dn} values were generally 40-60 db(A).

Table 3-1. MEASURED* SULFUR DIOXIDE, TOTAL SUSPENDED PARTICULATE, AND PARTICULATE FLUORIDE GROUND-LEVEL CONCENTRATIONS AT THE FARMLAND INDUSTRIES, INC. MINE SITE.

Parameter	Number of Observations	Measured Concentrations (Arithmetic Mean Values in $\mu g/m^3$)
Sulfur Dioxide	7122**	3.48
Total Suspended Particulate (24-hr)	192***	24-32
Particulate Fluoride (24-hr)	175****	0.03-0.05

*Measurements using standard operating procedures meeting the PSD requirements as described in 40 CFR 58, Appendix B.

**Data from one (1) Meloy 5A185-2A continuous SO_2 analyzer during the period January 15, 1979 - January 28, 1980.

***Data from four (4) high volume total suspended particulate matter samples over the period January 15, 1979 - January 31, 1980.

****Data from particulate samples collected by four (4) high volume total suspended particulate matter samples over the period January 15, 1979 - January 10, 1980.

3.1.2 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

3.1.2.1 The No Action Alternative

Under the no action alternative the meteorologic and noise characteristics of the site would likely remain as described in Section 3.1.1. However, air quality changes may occur because of emissions from new sources which may be permitted in the region in years to come, or because of changes in fuels used at existing sources.

3.1.2.2 The Action Alternatives, Including the Proposed Action

3.1.2.2.1 Mining

Dragline Mining (Farmland's Proposed Action). The draglines used in the proposed mining operation would be electrically powered and thus would not increase combustion emission levels. Some increase in ambient TSP levels may occur as a result of the handling of overburden and matrix by mining equipment. This should be minimal because of the wet nature of these materials.

Fugitive dust emissions in the mining area will be minimized by maintaining a vegetative cover on all reserve land until mining is imminent. In the interim between land clearing and mining, some land will be exposed and subject to activity that may generate fugitive dust emissions. Between 50-200 acres will likely be in this category at any given time. Fugitive dust emissions generated from such areas should be comparable to dust emissions from grove cultivation and other existing agricultural operations. If open burning is conducted, particulate matter, nitrogen oxides, sulfur dioxide, carbon monoxide, and hydrocarbons will be emitted. However, because the vegetation on the portions of the site which are to be cleared is relatively sparse very little burning will be required.

Noise levels in the vicinity of active mining areas will increase slightly. L_{dn} values of 65-70 db(A) may occur near (200 ft from) clearing operations. Sound pressure levels of 56-62 db(A) have been recorded at similar distances from operating draglines. During most of the 20-year mining period, noise levels in the Town of Ona will not be increased by dragline operation. Some increase may occur during years 16 and 19, when the mining operation is closest to Ona.

Bucketwheel Mining. As in the case of draglines, bucketwheel excavators would typically be electrically powered; thus, air emissions would not be increased. There would likely be more handling of overburden on conveyor systems, etc., so that TSP emissions might be greater than for draglines. Fugitive emissions from cleared areas and emissions from open burning would be similar to those for dragline mining.

Because of the additional handling equipment needed, noise levels from bucketwheels would probably be greater than would be experienced using draglines.

Dredge Mining. It is assumed that dredges would also be electrically powered; however, they would likely produce lower TSP levels than either draglines or bucketwheels because of the slurry handling of overburden and matrix. Noise levels would likely be similar to those expected for dragline mining.

Fugitive emissions from cleared areas and emissions from open burning would be similar to those for dragline mining.

3.1.2.2.2 Matrix Transport

Slurry Transport (Farmland's Proposed Action). Matrix would be pumped in a water slurry from the active mine pit to the beneficiation plant. The pumps used would be electrically powered; thus no significant emissions should result.

Data presented by EPA (1979a) indicate that the noise levels associated with matrix pumping are minor when considered in combination with the nearby dragline. A peak SPL of 62 db(A) was recorded for a dragline alone, as compared to a peak of 68* db(A) for dragline and slurry pit pump together.

Conveyor Transport. Matrix would be placed on an electrically-powered belt conveyor for transport from the active mine pit to the beneficiation plant. TSP levels near the conveyor would likely be higher than if slurry pumping were used.

Noise levels associated with conveyor transport would be greater than for slurry pumping. Woodward-Clyde Consultants (1981) indicates that L_{dn} levels on the order of 70 db(A) could occur at a distance of 125 ft from such an operating conveyor. Levels on the order of 60 db(A) would occur at 1250 ft. This noise would also occur along the total length of the conveyor.

Truck Transport. Matrix would be transported over haul roads to the beneficiation plant in large diesel-powered trucks. This would result in higher TSP as well as combustion emissions than either slurry transport or conveyor transport.

Noise levels associated with truck transport would also be substantially higher than for slurry pumping. The noise produced would be more intermittent than for conveyor transport, but could be of a higher level when it occurs (i.e., when a truck would pass by).

3.1.2.2.3 Matrix Processing

Conventional Matrix Processing (Farmland's Proposed Action). Conventional matrix processing methods utilize flotation reagents in order to separate waste materials from the phosphate rock. Since some of these reagents are volatile (e.g., kerosene), local increases in their atmospheric levels are expected.

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*Included outside noises as well.

Noise levels associated with a conventional matrix processing plant are presented by EPA (1979a). At a distance of 225 ft, the average SPL was determined to be 72 db(A). The anticipated L_{dn} value for the operating plant is expected to be on the order of 60 db(A) at a distance of 900 ft (Woodward-Clyde Consultants 1981). This will result in a contribution of about 40 db(A) to the composite L_{dn} noise level at the Town of Ona.

Dry Matrix Processing. Dry processing would require that matrix be dried, crushed, and sized (by air separation and/or electrostatic separation). This would require the burning of fuel (for drying) and result in elevated air pollutant (e.g., TSP) levels in the area.

Noise levels associated with a dry matrix processing plant are expected to be somewhat greater than discussed above for conventional (wet) processing.

3.1.2.2.4 Reclamation

Farmland's Proposed Reclamation Plan. Farmland proposes to reclaim much of the mine site as agricultural land. This will require that the windrows of overburden created during the mining operation be leveled using heavy equipment. The operation of this equipment will result in local increases in combustion emission levels.

The operation of heavy equipment during leveling, etc. would result in increased noise levels in the area. Data presented by EPA (1979a) indicate that such SPLs could be on the order of 36-93 db(A) within the area being reclaimed (i.e., at distances of 30-200 ft). The maximum values measured were at close proximity (30 ft) to an operating pay-scraper. Noise levels would be mostly on the order of 75 db(A) at a distance of 200 ft.

Conventional Reclamation. Conventional reclamation is the type of reclamation which has been practiced in the Florida phosphate industry over the past years. Major features of this type of reclamation are the creation of extensive areas of improved pasture on reclaimed clay settling areas and numerous land and lake areas.

Because of the nearly flat topography which results from the settling of clay with the separate disposal areas, little grading of such areas would be necessary to produce a surface suitable for use as pasture. Therefore, emissions and noise levels from equipment would likely be less than for reclamation of sand-clay mix areas. The net difference would be dependent upon the amount of ditching, etc., required to dry the upper layer of separate clay disposal areas to the point where seeding could be accomplished.

Natural Mine Cut Reclamation. Natural mine cut reclamation would eliminate the need for overburden leveling, etc., and thus result in a decrease in the amount of combustion emissions from heavy equipment. The noise levels associated with the operation of this equipment would also be less than for Farmland's proposed reclamation plan and less than conventional reclamation.

3.2 GEOLOGY AND SOILS

3.2.1 THE AFFECTED ENVIRONMENT

3.2.1.1 Geology

The Farmland site is located in the northern portion of the DeSoto Plain physiographic province, just south of the Polk Upland. Elevations at the site average about 80 to 85 ft on this relatively flat plain.

The site area is underlain by an average of 20.5 ft of Pliocene to Recent surficial deposits consisting primarily of sand and clay. Beneath the surficial deposits is the upper Hawthorn Formation (of Miocene age), which averages about 20.5 ft in thickness and is the ore bearing zone. At the base of the ore zone are clays and limestones comprising the lower Hawthorn Formation.

With respect to the underlying basement structure, the site is situated within the western portion of the Osceola low, on the southwest flank of the Ocala uplift. The Osceola low was downdropped along the Kissimmee faulted flexure during formation of the Ocala uplift in Mesozoic time. These features represent local basement structures on the western flank of the Peninsular Arc of Florida.

Shallow marshy depressions occurring in the area may have resulted from local solutioning of discontinuous limestone lenses within the overburden. However, a high piezometric surface (well above the limestone bedrock) has been found in the area; thus, karst development resulting from solutioning and collapse is highly unlikely.

3.2.1.2 Soils

The nearly level and gently sloping soils on the Farmland mine site are representative of large areas of Hardee and surrounding counties. Most of these soils are deep, very sandy (about 96 percent), acidic (pH of 4 to 5) and generally low in fertility for crop production (see Tables 3-2 and 3-3). They are also characterized as having generally poor surface and internal drainage. These soils support the following crops, vegetation, or land use on the Farmland site in decreasing order of acreage: improved pasture/cropland, citrus, forested wetlands, pine flatwood/palmetto range, forested uplands and non-forested wetlands.

3.2.1.2.1 Soil Types

Soil types on the mine site were first mapped in 1950 by the U.S. Department of Agriculture (USDA), Soil Conservation Service (SCS). Fifteen soil types were mapped in the 1950 soil survey (Figure 3-2), with apparent minimum delineations of less than 2 acres. In 1979, approximately 1250 acres of the northern portion of the mine site (Sections 27, 28, 34, 35, and part of 36) were remapped by the SCS as part of an updated soil survey of Hardee County. More differences in soils were recognized in the 1979 soil survey--resulting in more soil types mapped, and some changes in soil designations.

Table 3-2. PARTICLE SIZE DISTRIBUTION FOR NATURAL SOIL ON THE FARMLAND INDUSTRIES, INC. SITE AND SOIL MATRIX PROCESSING WASTE MATERIALS.

	Surface Soils* (0-6")	Sand:Clay Mix		Tailing Sand	Phosphatic Clay	Overburden**		
		0.8	4.6			2-5 feet	5-10 feet	10-20 feet
% Sand	96.4	63.8	83.8	100	19.8	89.7	82.9	58.0
% Silt	1.7	14.5	7.0	0	32.7	2.1	1.2	4.5
% Clay and Colloidal Organic Matter	1.9	21.7	9.2	0	47.5	8.2	15.9	37.5

*Averages for 8 range, pasture and cropped soils.
**Averages for 3 samples.

Source: Zellars-Williams, Inc. (1978).

Table 3-3. CHEMICAL DATA FOR NATURAL SOIL ON THE FARMLAND INDUSTRIES, INC., SITE AND MATRIX PROCESSING WASTE[1].

	Soil 0-6 inches		Sand:Clay Mix[3]		Tailing Sand	Phosphatic Clay	Overburden[4]					
							2-5 feet		5-10 feet		10-20 feet	
	Native Range	Crops and Pasture[2]	0.8	4.6			Native Range	Improved Pasture	Native Range	Improved Pasture	Native Range	Improved Pasture
Calcium (Ca) lbs/acre	360	995	>20,011	>20,011	>3,999	>20,011	324	>1,948	264	>3,999	>3,999	>3,999
Magnesium (Mg) lbs/acre	66	78	7,889	6,849	112	7,890	12	142	11	681	95	1,602
Phosphorus (P) lbs/acre	8	30	>666	>666	>133	>666	>133	>133	>133	>133	>133	>133
Potassium (K) lbs/acre	40	30	403	203	17.0	901	4	18	5	30	24	340
pH	4.2	5.0	7.6	7.7	6.3	7.7	4.4	5.5	4.6	5.7	4.6	7.1
Ra-226 Picocuries per gram	>0.1	0.3[5]	4.1	3.3	2.4	6.1	-	-	6.2[6]	3.0[6]	32.3	5.6

[1] Calculated or taken from Radiation and Agricultural Productivity Analysis of Reclaimed Soils for Farmland's Hardee County Mine, Zellars-Williams, Inc. June 1978.

[2] Averages for 2 crops and 2 types of pasture. Radium-226 for improved pasture only.

[3] Tailing sand and phosphatic clay from beneficiation.

[4] Approximate depths.

[5] True value may be ± 50% because of less than optimum sample size.

[6] From 0.5 to 10 feet depth.

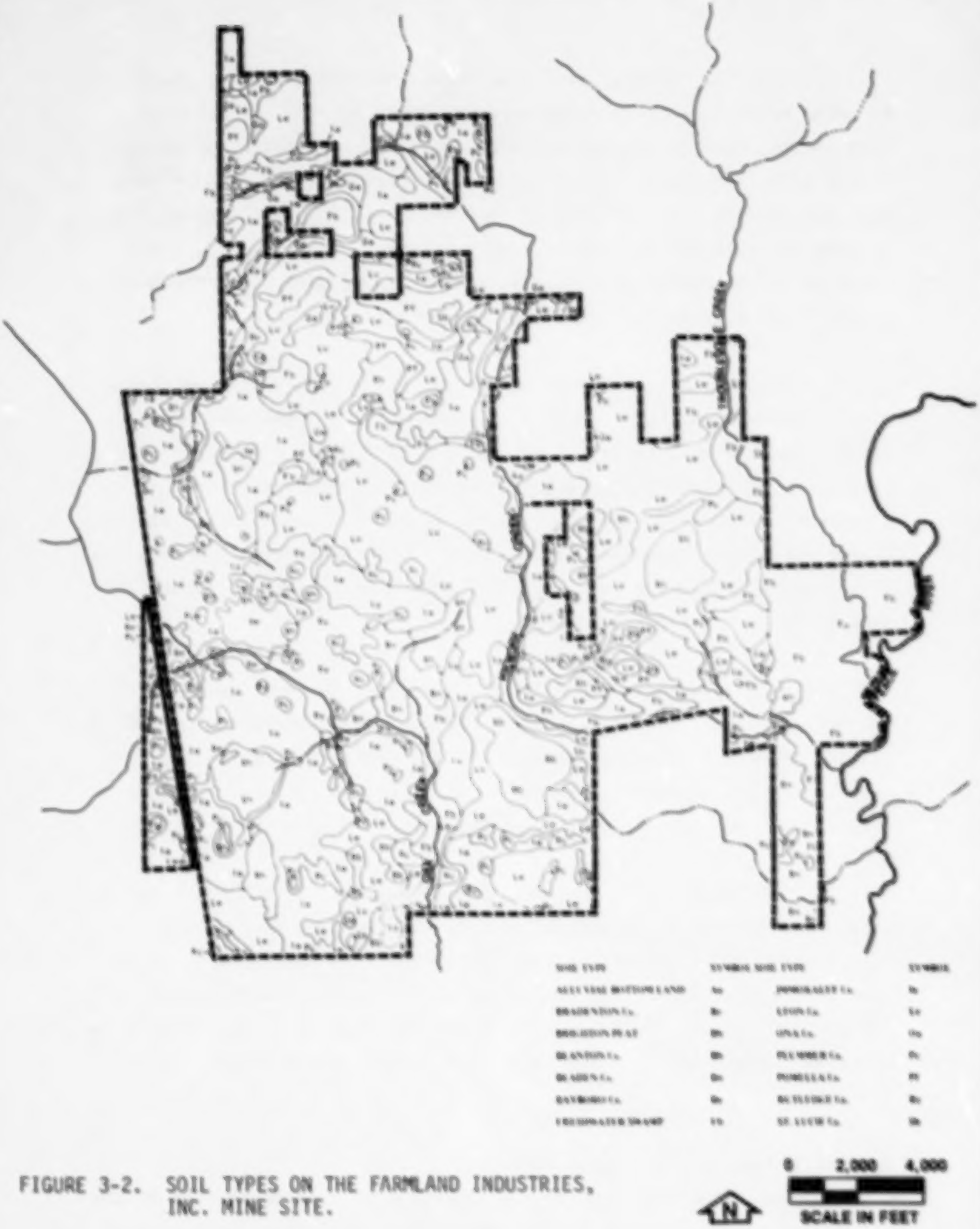

FIGURE 3-2. SOIL TYPES ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

Soils at the Farmland site were formed on sand deposits, which occurred during the Pleistocene epoch of geologic time. Of the five soil forming factors (parent material, topography, climate, plant and animal life, and time), parent material, topography, and climate were most involved in the formation of the site soils. In particular, the soil-water relations in this area of relatively high rainfall, coarse textured soils, poorly developed surface drainage and relatively high groundwater, greatly influence soil characteristics.

A relatively small area of soils (approximately 10 percent of the site) is mapped as organic soil (peat or muck), the remainder being mineral soils with less than 2 percent organic matter. The peat and muck soils are generally located in broad, low flats vegetated with freshwater marsh/swamp species. While the mineral soils lie at slightly higher elevations than the organic soils, it is estimated that soils in 75 percent of the areas have slopes of less than 2 percent; slopes rarely, if ever, exceed 5 percent.

All soils are very deep. Typical soil profiles are described by the SCS to greater than 55 inches in depth, and to an average of over 70 inches. However, these soil depths are not indicative of rooting depths, for the relatively shallow groundwater tables present during much of the year inhibit root development at such depths.

The SCS descriptions indicate that all of the mineral soils in the area are comprised of 85 percent or more fine sand or sand in the surface layers. Clay content of all mineral soils is estimated to be less than 10 percent, except for some areas where clay was found below a depth of 30 inches. Surface soils on the Farmland site were found to be about 96 percent sand and 4 percent silt, clay, and colloidal organic matter.

3.2.1.2.2 Drainage and Permeability

Drainage from all soils on the mine area is limited because of the relatively high groundwater table and the lack of well-defined surface drainage systems. Approximately 10 percent of the land area is very poorly drained, implying that the water table remains at or on the surface a great part of the time. Over 75 percent of the land area is estimated to be poorly drained, with the water table commonly at or within 10 inches of the surface for 2 to 6 months a year.

Surface soils of the Farmland site are considered to be permeable (5-10 inches/hour), but the permeability of more than 60 percent of site soils is restricted by a hard pan located between 20 and 40 inches beneath the surface. This pan, which may be 10 to 20 inches thick, has a permeability of about 0.8-2.5 inches/hour.

3.2.1.2.3 Acidity

Nearly all the soils of the Farmland site are acidic. The organic soils (peat and muck) are extremely acid (pH below 4.5), but are of limited extent (10 percent). The soils over about 60 percent of the site area are very strongly acid (ph 4.5 to 5.0) through the surface horizons, and strongly acid (ph 5.1 to 5.5) in deeper horizons. The remaining mineral soils range from neutral to strongly acid.

3.2.1.2.4 Agricultural Productivity

The soil acidity, low clay content, and low organic matter content of most of the soils of the Farmland site contribute greatly to the low availability of most plant nutrients for growing crops. In their 1979 soil survey, the SCS assigned capability classes to soils found on the Farmland site. Capability classes range from Class 3 soils having severe limitations that reduce the choice of plants, require special conservation practices, or both, to Class 7 soils having very severe limitations that make them unsuited to cultivation and restrict their use largely to pasture, range, woodland, and wildlife. More than half of the site area is comprised of Class 4 soils having very severe limitations that reduce the choice of plants, require very careful management, or both. The capability limitation on approximately 90 percent of the area is water, in or on the soil surface, interfering with plant growth or cultivation. The limitation on the remaining soil area is droughtiness.

3.2.2 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

3.2.2.1 The No Action Alternative

Under the no action alternative the geologic features of the site would likely remain as described in Section 3.2.1. The existing soils would continue to support an established vegetative cover, grazing land for livestock, and the production of limited agricultural crops. While current land use will not apparently adversely affect existing soils, with the possible exception of slight erosion, it will not significantly benefit them either. Therefore they are not expected to support significantly greater agricultural productivity than at present.

3.2.2.2 The Action Alternatives, Including The Proposed Action

3.2.2.2.1 Mining

Dragline Mining (Farmland's Proposed Action). Dragline mining requires that woody vegetation be removed from the areas to be mined in advance of the actual mining operation. This will disturb surface soils and may result in increased soil erosion. While mining is to proceed at a rate of about 250 acres per year, Farmland indicates that the average advance clearing in front of the mining operation will be about 20 acres. The resultant impact (beyond that of actual mining) should be small.

Dragline mining will disturb the surface soils, entire overburden section, and the upper portion of the Hawthorn Formation containing the phosphate matrix over 4951 acres of the 7810-acre Farmland site. The total depth of disturbance will average about 41 ft, with a maximum of about 75 ft. Soils in the areas to be mined will undergo major disturbance and loss of identification.

Solution cavities are known to exist in the Ocala Group, which lies at a depth of 400 ft or more in this area. Due to the great depth to these units, no collapse features should result from loading, construction or other near surface activities. In addition, there will be no increase in solutioning activity resulting from mining activities, as the water table will not be lowered below the limestone units. Therefore, no collapse features resulting from the planned activities on local conditions are anticipated.

Dredge Mining. As with dragline mining, dredge mining would result in the disturbance of surface soils in advance of the mining operation, and total disturbance of the entire overburden section during mining. The pre-mining disturbance may be greater than that for dragline mining because of the dredge's materials handling limitations (e.g., stumps, etc.).

Bucketwheel Mining. The impacts of bucketwheel mining on geology and soils would be essentially the same as those of dragline mining, described above.

3.2.2.2.2 Waste Sand and Clay Disposal

Sand-Clay Mixing (Farmland's Proposed Action). Most of the waste sand and clay generated by the processing of matrix will be disposed of through sand-clay mixing. These materials will also be stored separately where sand-clay mixing is not feasible, so that portions of the site will also have surfaces covered by these separate waste products. The areas to be occupied by the various waste products are: sand-clay mix, 3915 acres; clay, 1078* acres; and sand, 104 acres. The locations of the various disposal areas are shown in Figure 2-6 (page 2-9).

Selected physical and chemical properties of sand, clay, and sand-clay mix materials from the Farmland site were determined by Zellars-Williams, Inc. (1978). Farmland site soil samples were also collected.

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*The 1078 acres of impounded clays include Areas I (495 acres) and II (583 acres). Clays from Area I will be dredged for use in sand-clay mixing prior to the completion of mining. Therefore, only 583 acres of separately impounded clays will remain at the end of the life of the mine.

Sand-clay mixtures covering the expected ratios to be used in Farmland's mining operation (1.9:1 to 3.1:1) were also prepared for analysis by Bromwell Engineering, Inc., of Lakeland, Florida. These mixtures had sand:clay ratios of 0.8 and 4.6 (on a weight basis). Laboratory analyses performed on each of the materials described above included: calcium, magnesium, phosphorus, potassium, and Radium-226 content; pH; and particle size distribution. Particle size and chemical data, including radio-chemical data, are presented in Tables 3-2 and 3-3, respectively. The physical and chemical characteristics of the various waste materials are discussed in the following paragraphs.

Sand-Clay Mixture. The two sand-clay mixtures tested would be classified as either a sandy clay loam or a loamy sand. Data in Table 3-2 show that tailing sand, one component of the sand-clay mix, is 100 percent sand. The other component, phosphatic clay, contains approximately 20 percent sand, 33 percent silt, and 47 percent clay-sized particles.

The chemical characteristics of the sand-clay mixes (Table 3-3) are also agriculturally superior to those of the natural pre-mining soils. Amounts of phosphorus, potassium, calcium, and magnesium generally range from 10 to 100 times greater in the mixes. The higher levels of these plant nutrients are in the range of normally productive soils, and would prevent the need for adding fertilizers containing these particular nutrients. The increased pH values of the mixes indicate that the application of lime (formerly required on the pre-mining soils for economical agricultural production) will not be required for the sand-clay mix. Applications of nitrogen fertilizer will be required on the mixes in order to maximize agricultural production, which is also true for the existing soils. Increased nitrogen use efficiency on the sand-clay mixes is anticipated because of reduced leaching rates and adsorptive properties of the clay.

Considerably more radioactivity is associated with the sand-clay mixes than with the natural pre-mining soil. The data suggest that the phosphatic clay contributes more radioactivity than the tailing sand. These levels of radium-226 (Ra-226) are within the range projected for similar mining developments.

Clay. The undesirable agricultural characteristics of waste clay include poor tilth, delayed seed bed preparation, and cool soil temperatures. Such clays also present limitations with regard to future development (i.e., poor foundation material).

The chemical characteristics of clay waste, as evaluated from the laboratory data obtained, are at lease as favorable as those of the sand-clay mixes and much superior (agriculturally) to those of the premining soils.

Sand. The most undesirable agricultural characteristic of waste sand is its inability to retain water. For this reason it is not suitable as a seed bed or root zone material. Because of these limitations, Farmland proposes to cap sand disposal areas with a 2-foot layer of overburden (see next section).

Chemical analyses of waste sand indicate that, with the exception of potassium, it contains higher nutrient levels than existing surface soils.

Conventional Sand and Clay Disposal. Disposal of waste sand and clay as conventionally practiced in the Florida phosphate industry would increase the extent of the site to ultimately be covered with diked clay wastes from 583 acres (using sand-clay mixing) to about 2500 acres. Such areas would have limitations similar to those described above for the separate clay disposal area under Sand-Clay Mixing. The larger dikes, etc., used for conventional clay disposal would also be of greater height than those for sand-clay mix areas and could be more susceptible to erosion.

3.2.2.2.3 Reclamation

Farmland's Proposed Reclamation Plan. The physical characteristics of the sand-clay mixtures to be used in reclamation will be agriculturally superior to those of the natural pre-mining soils. The larger proportion of clay and other larger size particles in the sand-clay mix will greatly increase the water holding capacity in the vegetation root zone and, to some degree, alleviate the droughtiness associated with the pre-mining soils. This added water holding capacity will also reduce the rapid leaching of soluble plant nutrients. The improved soil structure will also likely result in increased organic matter accumulation over a period of years.

Areas of separately stored clays will have more limited value because of their undesirable agricultural characteristics. With proper drainage, however, they should at least be suitable for pasture. The structural stability problems associated with such areas are an additional major concern.

Areas of separately stored sands will be capped with a 2-foot layer of overburden. Particle size data presented in Table 3-2 indicate that the overburden consists of strata in which particle size ranges from a sand to a sandy clay loam. These soil textures encompass the range of those previously discussed for the sand-clay mixes. All of the overburden textures represent a marked improvement for agricultural use relative to the pre-mining soil. Chemical analyses of overburden (Table 3-3) indicate differences in nutrient concentration between the strata. The calcium, magnesium, and potassium concentrations in overburden to the 100-foot depth were found to be lower in natural native range soil. Conversely, overburden values of these nutrients were much higher than found in natural improved pasture soil. In most cases overburden from strata deeper than 10-foot was found to be of higher nutrient content than the pre-mining soils. However, the relatively lower pH values (e.g., 4.4-5.7) found for overburden samples suggest that liming will be necessary for optimum growth of many crops.

Conventional Reclamation Plan. Reclamation as conventionally practiced in the Florida phosphate industry would increase the area of the site covered with soils of limited agricultural value (i.e., clays). Under Farmland's proposed plan, the extent of such areas would be about 600 acres. Using conventional methods, this area would increase to about 2500 acres.

The land areas of the site reclaimed with material other than waste clays would likely be graded overburden. The surface soils of such areas would be quite variable, depending on which strata became the new surface (see discussion of overburden cap for waste sand disposal area). Such areas would likely be suitable for use as improved pasture.

Conventional reclamation would also result in the creation of more extensive lakes than would Farmland's proposed plan. This would reduce the land surface available for agricultural usage.

Natural Mine Cut Reclamation. Natural mine cut reclamation differs from both Farmland's proposed reclamation plan and conventional reclamation in that the overburden windrows created by the mining operation would not be graded and reclaimed as pasture. The landscape would be very irregular, resulting in soil erosion. Revegetation would also occur, eventually stabilizing most areas. The productivity of such soils would be limited to wildlife habitat. Natural mine cut reclamation in combination with sand-clay mixing would produce the smallest overall land acreage suitable for agricultural use (about 600 acres of settled clays). Conventional sand and clay disposal combined with natural mine cut reclamation would result in the creation of much larger areas of such soils (about 2500 acres of settled clays).

3.3 RADIATION

3.3.1 THE AFFECTED ENVIRONMENT

Naturally-occurring radionuclides such as uranium, thorium, and their decay products, as well as tritium, carbon-14, and potassium-40, are ubiquitous in nature and usually distributed uniformly. However, some geological strata (such as marine phosphorite deposits) contain significantly elevated concentrations of uranium, thorium, and their decay products. The phosphate deposits of Florida are an example of such strata and contain concentrations of uranium and its decay products at levels about 30 to 60 times greater than those found in average soil and rock. The presence of this radioactive material in extensive land areas in central Florida creates the potential for radiation exposure of the general population living on or near this land. The naturally-occurring background levels can be both significant and highly variable. The mining and processing of phosphate ore redistribute the radioactive material in the biosphere, thus offering some potential for altering the existing radiological environment by releasing some of these materials as gases, airborne particulates, or water-borne effluents.

The phosphate deposits of central Florida contain average uranium (primarily U-238) concentrations of about .1 to .4 pounds per ton (EPA 1977). The uranium is usually in equilibrium with its radioactive decay products. Radioactivity is also present in parts of the overburden, specifically the "leach zone". This zone, also called the aluminum phosphate zone, is a discontinuous zone of altered friable phosphatic sandstone above the matrix, varying in thickness from 1 to 10 ft. It is composed of quartz sand cemented and indurated by the secondary minerals such as wavellite, crandallite, and (locally) millisite. Also occurring is a fine-grained secondary cement composed of kaolinite and aluminum phosphate minerals. If a "leach zone" exists above the ore, it usually contains uranium in concentrations comparable to that of the matrix. Other portions of the overburden may also contain elevated radioactivity as compared to the surface soils. However, the radioactivity is generally associated with the phosphate itself, since the uranium replaces the normal calcium in apatite. Consequently, the marketable ore and waste clays containing most of the phosphate also contain most of the associated radioactivity. Two-thirds of the phosphate originally contained in the matrix remains in the marketable rock, with the remainder primarily in the waste clays.

Soil throughout the U.S. typically contains between 0.2 and 3 picocuries (pCi) of Ra-226 per gram. Unmined, reclaimed, and disturbed phosphate land can contain widely varying concentrations of Ra-226, the amounts being related to the amount of low activity overburden and sand tailings present as compared to higher activity matrix, waste clays, or leach zone material. The presence of Ra-226 and its decay products in soil presents a potential source of gamma exposure to individuals living or working above the soil. Of greater concern is exposure arising from the release of radon-222 (Rn-222), a noble gas decay product of Ra-226 with a 3.85-day half-life. It may diffuse through the soil into the atmosphere. Observed Rn-222 concentrations in the air are highly variable due to the influence of factors such as precipitation, barometric pressure, and atmospheric thermal stability.

3.3.1.1 Uranium Equilibrium

In the uranium-238 series, the decay proceeds through 13 intermediate daughter radionuclides until the stable nuclide lead-206 (Pb-206) is reached. The nature of the series is such that a condition of equilibrium is achieved only if the entire series remains undisturbed in a "sealed" location over a long period of time. Mining produces a considerable disturbance of the natural condition, leading to new transport pathways. This disturbance may cause the higher activity leached zone material and small quantities of the matrix to be redeposited near the ground surface upon reclamation. In some cases, mined land is reclaimed with by-product materials (waste clays) from the processing of the phosphate matrix. These materials contain approximately one-third of the uranium originally present in the matrix.

3.3.1.2 Background Radiation

External whole-body gamma radiation exposure levels for Floridians are essentially equal to those reported for the average U.S. citizen, (i.e., approximately 100 millirems per year). Increases in external gamma radiation levels are associated with materials used for construction (primarily roadways) and varied histories of land use (primarily phosphate mining and reclamation), although nearly all are within the range of background. Direct radiation levels over the Farmland property are roughly 43 millirads per year. Samples of total suspended particulates indicated levels of airborne gross alpha radioactivity which were less than 0.1 picocuries per cubic meter.

3.3.1.2.1 Air

Exposures from air result principally from Rn-222 gas (and its particulate daughter products) originating from the decay of Ra-226 in soils. Lung dosage from Rn-222 is 0.240 rads per year in the Bone Valley area, compared with 0.130 in the remainder of the state. The mean annual natural background working-level (WL)* concentration for the area is 0.004 compared with an inferred U.S. average of 0.001.

In the natural state, most of the Rn-222 (an inert gas) produced in a phosphate matrix would not escape the media. Mining and beneficiation alter the location of the Ra-226 and may increase the release of Rn-222 through the soil-air interface. Airborne radon and radon progeny can impart a large radiation dose to the lungs in enclosed spaces.

3.3.1.2.2 Water

In water, the principal radiological contaminant is Ra-226. Lower Floridan Aquifer water samples from non-mineralized areas of central Florida exhibit a mean value of 1.4 pCi/1, while those from the Upper

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*Radiation standards for exposure to Rn-222 and its short-lived daughters are expressed in terms of workling level (WL) concentrations. One WL is the amount of any combination of short-lived radioactive daughters of Rn-222 in 1 liter of air that will release 1.3×10^5 MeV of alpha energy during their decay to Pb-210.

Floridan (Secondary Artesian) contain about 5.1 pCi/l. In mineralized but unmined areas, these values increase to 2.0 and 2.3 pCi/l, respectively. Surficial Aquifer water samples from these areas contain about 0.17 pCi/l. In mineralized but mined areas, these values are 1.96 (Lower Floridan), 1.61 (Secondary Artesian), and 0.55 pCi/l (Surficial). Water samples collected from the Farmland site were found to have the following Ra-226 concentrations:

Surface Water -	0.6 pCi/l
Surficial Aquifer -	1.0 pCi/l
Secondary Artesian Aquifer -	15.6 pCi/l
Floridan Aquifer -	4.3 pCi/l

3.3.1.2.3 Structures

Radioactivity concentrations in homes and other structures built on reclaimed land have been shown to be higher than in structures located on land outside the mineralized phosphate area. The average annual exposure to daughters of Rn-222 above natural background for persons living on reclaimed land within the central Florida phosphate region is calculated to be 540 millirems per year to the whole lung.

3.3.1.3 Subsurface Radioactivity

In both the north Florida and west central Florida mining regions, the radioactivity is low at the surface, increases gradually and then more rapidly with depth and is most concentrated in or just above the matrix. If present, the "leach zone" (see Section 3.3.1) is usually marked by high radioactivity.

Samples of materials from the Farmland site were taken in order to make reasonably accurate predictions of the radiological and agronomic properties of the reclaimed soils expected on the site. Samples of topsoil, composite overburden, leach zone (if present) matrix and matrix components for several drill holes were analyzed for Ra-226 (Table 3-4). Splits from two cores were also analyzed for uranium and thorium (Th-230) (Table 3-5). Samples of composite clay, composite sand, and three

Table 3-4. RADIUM-226 ANALYSES OF CORE SAMPLES FROM FARMLAND INDUSTRIES, INC. HARDEE COUNTY PROPERTY.

Sample	Component	Radium-226 Content (Picocuries per gram)	BPL Content (%)
(B.D.-1)	Top Soil (0-0.5')	< 0.1	0.8
	Composite Overburden (0.5-10')	6.2	3.3
	Composite Overburden (10'-20')	32.3	9.2
	Matrix (20'-32')	9.7	19.4
	Pebble	32.3	29.4
	Concentrate	30.2	70.4
	Tailings	3.3	4.5
	Slimes	12.2	14.0
(B.D.-3)	Top Soil (0-0.5')	0.3	0.5
	Composite Overburden (0.5-10')	21.4	14.4
	Composite Overburden[1] (10'-26.5')	7.1	15.3
	Matrix (26.5'-47')	6.8	23.0
	Pebble	32.9	49.4
	Concentrate	23.8	66.3
	Tailings	0.7[2]	1.5
	Slimes	4.6	18.8
(B.D.-4)	Top Soil (0-0.5')	0.3[2]	1.1
	Composite Overburden (0.5'-6')	3.0	1.0
	Leach Zone (6'-10')	6.4	9.8
	Composite Overburden[1] (10'-15')	5.6	14.2
	Matrix (15'-36')	8.5	12.6
	Pebble	29.8	58.4
	Concentrate	26.0	67.9
	Tailings	3.2	4.2
	Slimes	5.0	13.4

[1] Overburden actually low grade matrix considered unmineable by geologist present.

[2] Due to the small quantity of sample submitted for analysis, these results could vary by 50 percent.

Source: Environmental Science and Engineering, Inc.

Table 3-5. RADIOMETRIC ANALYSES OF CORE SAMPLES FROM THE FARMLAND INDUSTRIES, INC. MINE PROPERTY.

Core Sample	Split	Depth	Description	Results of Analyses (pCi/g)			
						Radium-226	
				Uranium[1]	Thorium-230[1]	Analysis 1[1]	Analysis 2[2]
B.D.-1	1	0-5'	Loose sands	4.7	4.6 ± 1.6	2.0 ± 0.6	<0.2
	2	5-7.5'	Organic leach	1.0	1.1 ± 0.3	1.6 ± 0.5	2.0
	3	7.5-12'	Upper sandy clay	9	18 ± 3	16 ± 5	27.2
	4	12-20'	Soupy sand and leach	22	24 ± 4	22 ± 7	35.5
	5	20-25'	Matrix	11	18 ± 5	22 ± 7	13.4
H-15	1	0-10/5'	Loose sand and sandy clay				5.1
	2	10.5-46.5'	Upper soupy sand				11.4
	3	46.5-50'	Matrix				5.6
A-13	1	0-6'	Loose sand	0.17	0.39± 0.26	0.18± 0.05	0.7
	2	6-16'	Hardpan and sandy clay	3.1	7.5 ± 2.3	4.9 ± 1.5	7.7
	3	16-25'	Leach zone	33	90 ±40	67 ±20	70.2
	4	25-40'	Matrix	4.7	9.4 ± 3.5	6.1 ± 1.8	14.6
B-2	1	0-8'	Loose sand				91.0[3]
	2	8-14.5'	Tough sandy clay				55.3
	3	14.5-18.5'	Leach zone				3.2[3]
	4	18.5-21'	Upper tough clays				12.6
	5	21-27'	Matrix				9.8
B.D.-3	1	0-5'	Loose sand				0.8
	2	5-12.5'	Leached upper clays				25.5
	3	12.5-29.5'	First matrix to overburden				8.4
	4	29.5-45'	Matrix				8.1
B.D.-4	1	0-2'	Loose sands				0.3
	2	2-8.5'	Clayey composite overburden				3.9
	3	8.5-20'	Matrix				13.8

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[1] Analyses done for Woodward-Clyde Consultants by Wilson Laboratories of Salina, Kansas.
[2] Analyses done for Farmland Industries, Inc. by Environmental Science & Engineering, Inc. of Gainesville, Florida.
[3] Radium-226 values appear to be off by an amount suggestive of mislabeling of these samples.

Table 3-5. RADIOMETRIC ANALYSES OF CORE SAMPLES FROM THE FARMLAND INDUSTRIES, INC. MINE PROPERTY, Continued.

Core Sample	Split	Depth	Description	Results of Analyses (pCi/g)			
				Uranium[1]	Thorium-230[1]	Radium-226	
						Analysis 1[1]	Analysis 2[2]
B.D.-1	1	0-5'	Loose sands	4.7	4.6 ± 1.6	2.0 ± 0.6	<0.2
	2	5-7.5'	Organic leach	1.0	1.1 ± 0.3	1.6 ± 0.5	2.0
	3	7.5-12'	Upper sandy clay	9	18 ± 3	16 ± 5	27.2
	4	12-20'	Soupy sand and leach	22	24 ± 4	22 ± 7	35.5
	5	20-25'	Matrix	11	18 ± 5	22 ± 7	13.4
H-15	1	0-10/5'	Loose sand and sandy clay				5.1
	2	10.5-46.5'	Upper soupy sand				11.4
	3	46.5-50'	Matrix				5.6
A-13	1	0-6'	Loose sand	0.17	0.39± 0.26	0.18± 0.05	0.7
	2	6-16'	Hardpan and sandy clay	3.1	7.5 ± 2.3	4.9 ± 1.5	7.7
	3	16-25'	Leach zone	33	90 ±40	67 ±20	70.2
	4	25-40'	Matrix	4.7	9.4 ± 3.5	6.1 ± 1.8	14.6
B-2	1	0-8'	Loose sand				91.0[3]
	2	8-14.5'	Tough sandy clay				55.3
	3	14.5-18.5'	Leach zone				3.2[3]
	4	18.5-21'	Upper tough clays				12.6
	5	21-27'	Matrix				9.8
B.D.-3	1	0-5'	Loose sand				0.8
	2	5-12.5'	Leached upper clays				25.5
	3	12.5-29.5'	First matrix to overburden				8.4
	4	29.5-45'	Matrix				8.1
B.D.-4	1	0-2'	Loose sands				0.3
	2	2-8.5'	Clayey composite overburden				3.9
	3	8.5-20'	Matrix				13.8

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[1] Analyses done for Woodward-Clyde Consultants by Wilson Laboratories of Salina, Kansas.

[2] Analyses done for Farmland Industries, Inc. by Environmental Science & Engineering, Inc. of Gainesville, Florida.

[3] Radium-226 values appear to be off by an amount suggestive of mislabeling of these samples.

sand-clay mixtures were also prepared and analyzed for Ra-226 (Table 3-6). The observed values are within the rather wide range commonly observed for corresponding samples in central Florida, although lower than average.

3.3.2 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

3.3.2.1 The No Action Alternative

Under the no action alternative the Farmland site would remain in its present radiological state. Subsurface radioactivity would remain in strata instead of being nearly uniformly distributed with depth. This would leave the outdoor gamma radiation and the Rn-222 flux lower than would be the case after land reclamation. In turn, any homes that are constructed on the land would have lower indoor radon progeny concentrations. Occupational radiation exposures would not occur, and small increments in lung doses to nearby residents (from inhalation of radioactive particulates) would be avoided.

3.3.2.2 The Action Alternatives, Including The Proposed Action

3.3.2.2.1 Mining

Dragline Mining (Farmland's Proposed Action). In the mining process, the overburden overlying the matrix is stripped away and deposited in an adjacent previously mined area as a series of spoil banks. As conventionally practiced, materials that were originally near surface would be placed at the bottom of the spoil pile, while the materials which were just above the matrix would be placed at the top of the pile. Core analyses have shown the Ra-226 profile in the site overburden to range from less than 1 pCi/g near the surface to a high of about 67 pCi/g in the leach zone at the overburden-matrix interface. Thus, dragline mining (as conventionally practiced) would result in the exposure of the leach zone and its relatively high radioactivity to the atmosphere. However, the direct radiological impacts to operating personnel near the mine should be minimal. Prince (1977) found the average external gamma

Table 3-6. RADIUM CONTENT OF COMPOSITE WASTES FOR FARMLAND RADIATION STUDY

Sample	Radium-226 Content (Picocuries per gram)
Composite Clay	6.1
Sand:Clay Ratio 0.8:1	4.1
Sand:Clay Ratio 4.6:1	3.3
Sand:Clay Ratio 10.1:1	2.8
Composite Sand	2.4

Source: Bromwell Engineering, Inc.

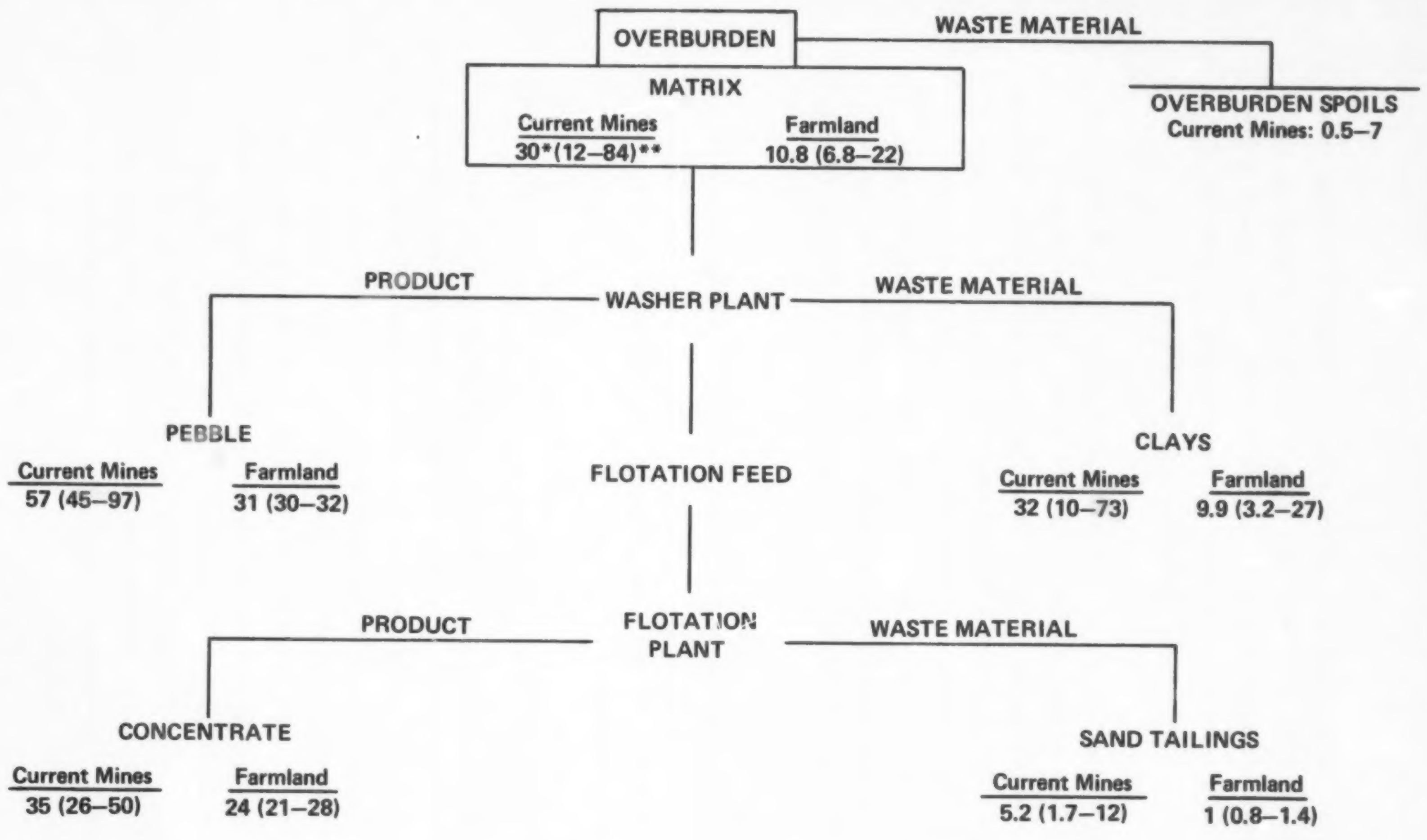
radiation levels in the vicinity of draglines to be about 5 μR/hr (near baseline). Radon progeny levels were also found to be present at low levels (0.0004 WL concentrations). This is a lower value than has been found within slab-on-grade structures on unmined land in Polk and Alachua Counties, which ranged from 0.001 to 0.032 WL.

Dredge Mining. Dredge mining, like dragline mining, would disrupt the natural occurrence of radioactive materials within the overburden. However, the redistribution of such layers would be more uniform because of the mixing which would occur during slurry transport of the overburden from the mine to the disposal area. Since the water used to transport the overburden would be in direct contact with radioactive materials, it is possible that some increase in the levels of radioactivity in these waters would occur even after most of the solids had settled.

Bucketwheel Mining. Bucketwheel mining, like dragline mining, would disrupt the natural occurrence of radioactive materials within the overburden, and result in the same potential for exposure of such material to the atmosphere.

3.3.2.2.2 Matrix Processing

Conventional Matrix Processing (Farmland's Proposed Action). The distributions of radioactivity within the matrix from selected existing mines (Roessler, et al. 1978) and for the Farmland site (Farmland 1979a) are shown in Figure 3-3. From the washer plant come a coarse product (pebble), an intermediate-sized product (flotation feed), and a fine clay waste product. The clays in west central Florida have about the same concentration of Ra-226 as the input matrix (both on a dry weight basis), the actual level being dependent upon the efficiency of the washer plant. In general, west central Florida clays average about 45 pCi/g Ra-226. Pilot plant studies with the matrix from the Farmland site indicate that the concentration in the separated clays should be from 4.6 to 12.2 pCi/g Ra-226.



* AVERAGE VALUE

** RANGE IN VALUES

FIGURE 3-3. RADIUM (in pCi/g) IN CURRENT CENTRAL FLORIDA PRODUCTS AND WASTES VS. EXPECTED VALUES FOR THE FARMLAND INDUSTRIES, INC. PROJECT.

SOURCE: FARMLAND INDUSTRIES, INC., 1979; ROESSLER, ET AL 1978

Flotation feed is routed to the flotation plant where concentrate and a sandy, waste fraction (termed sand tailings) are produced. The tailings at this site represent about 60 percent (by weight) of the incoming matrix. After separation, they contain only a small fraction of the matrix radioactivity. Samples from operating west central Florida mines were found to average about 5 pCi/g. Samples from the Farmland site indicate that these tailings should have a Ra-226 concentration of 1 to 3 pCi/g, a value which appears to represent a very efficient separation.

Prince (1977) found the external gamma radiation levels in beneficiation plants to be about twice the background levels. However, results of a work-station survey found occupancy factors low enough to reduce annual exposures to insignificant levels. Radon progeny levels were below the levels reported for slab-on-grade structures on unmined land (0.0007 WL). Therefore, the radiological impacts to operating personnel at the plant should be minimal.

Prince (1977), in his study of the occupational radiation exposures in the phosphate industry, found wet rock storage piles to yield gamma radiation at an average rate of 67 μR/hr. However, occupancy factors around such piles are extremely small, making the annual exposure to an individual insignificant. In areas where the occupancy factor is high, the elevation in gamma radiation was found to be low. Wet rock storage and transfer tunnels (located under wet rock piles) were found to be the most serious radiological hazard areas. WL measurements at 11 sites yielded levels between 0.0007 WL and 0.096 WL.

Dry Matrix Processing. Dry matrix processing would involve the separation of the matrix fractions by air or electrostatic methods. This dry separation would produce tremendous amounts of particulate matter, requiring the control of airborne radioactive particulates. Even with control measures, radioactivity in the area of the dry process beneficiation plant would likely be higher than if conventional methods were used.

3.3.2.2.3 Sand and Clay Waste Disposal

Sand-Clay Mixing (Farmland's Proposed Action). As indicated previously, the processing of matrix at the Farmland plant will produce two solid waste streams--clays and sand tailings. Both of these streams will contain radioactive materials. When these two wastes are combined at the proposed 2.5:1 ratio, a final Ra-226 concentration of about 3.5 pCi/g should exist. Pre-mining Ra-226 subsurface profiles (<1 pCi/g at the surface to 32 pCi/g near the matrix) will be altered to a reclaimed profile having from between 1 and 4 pCi/g nearly uniformly distributed with depth, but "spikes" are expected throughout because of the occurrence of matrix or high activity material ("leach zone") originally just above the matrix. Separately stored sand tailings should be more uniform, with Ra-226 concentrations being about 2.4 pCi/g throughout. Separately impounded clay sediments are expected to yield an average concentration of 6.1 pCi/g, but with both higher and lower "spikes".

The redistribution of radioactivity in waste sand and clay will also alter the terrestrial gamma radiation where these materials are deposited. Table 3-7 contains the predicted gamma radiation levels for sand and clay waste from the Farmland mine. These estimates consider the expected uranium, thorium, and potassium contents of various post-reclamation land types following Beck and dePlanque (1968), who give exposure rates in air for each ppm of uranium, thorium, and potassium in soils. The waste clay will emit the highest amount of gamma radiation (12.9 μR/hr @ 1m). However, only a small fraction of the site (12 percent) will be covered by this material, and its high water content may reduce the gamma level through shielding. The remainder of the waste products are expected to meet or only slightly exceed the 10 μR/hr interim recommendation for gamma exposure levels at new structure sites on Florida phosphate lands (EPA 1976). The mean outdoor gamma radiation of the site is expected to increase from 6.5 μR/hr to 11.9 μR/hr.

An additional concern about the waste materials is the amount of Rn-222 flux from them. The level of radon flux is considered an indicator

Table 3-7. PREDICTED GAMMA RADIATION CHARACTERISTICS OF RECLAIMED LAND ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

Land Type	Predicted Gamma μR/hr @ 1 m	Cosmic Contribution μR/hr	Total μR/hr
Overburden Reclaimed	6.1	3.6	9.7
Sand/Clay Mixture	8.3	3.6	11.9
Tailings Reclaimed	5.7	3.6	9.3
Clay Reclaimed	12.9	3.6	16.5

Source: Adapted from Beck and dePlanque (1968).

Table 3-8. PREDICTED RADON FLUX FROM RECLAIMED LAND ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

	Radon-222 Flux, pCi/m^2s	
Land Type	Without 2-ft of Topsoil	With 2-ft of Topsoil
Overburden Reclaimed	0.95	0.68
Sand/Clay Mixture	1.3	0.94
Tailings Reclaimed	0.91	0.66
Clay Sediments	2.3	1.7

Source: Adapted from Roessler, et al. (1978).

of the potential hazard of indoor radon progeny within slab-on-grade residential and public structures. Table 3-8 summarizes predicted radon flux values for various waste surfaces. The first column lists the results of a mono-layer diffusion model (without topsoil); the second column contains the values predicted by a bi-layer diffusion model (with topsoil). Specific parameters for each waste type were taken from the data of Roessler, et al. (1978) for similar media. For each land type, the reduction is between 20 and 30 percent. However, even the uncapped values are within the range of Rn-222 fluxes which have been observed on unaltered lands (Table 3-9). Therefore, the increase in outdoor airborne Rn-222 concentrations from these fluxes should be insignificant.

Conventional Sand and Clay Disposal. Conventional clay disposal would result in the separate disposal of sand and clay waste materials. This would create about 2500 acres of surface area with higher radiation levels (on the order of 6.1 pCi/g) than would result using sand-clay mix methods.

3.3.2.2.4 Reclamation

Farmland's Proposed Reclamation Plan. As indicated previously, the reclaimed mine site will have different radiological characteristics than the premined site. The resultant impact of this new radiological environment will depend upon the end land use of given areas and the levels of the various radiological characteristics. Farmland's reclamation plan calls for the return of much of the site area to agricultural usage. There is no evidence that agricultural development of the reclaimed mine site will pose a significant radiological hazard through soil-to-crop-to-man food chain uptake. However, little is known about the behavior of Ra-226 uptake from this type of soil. A very limited study (Bolch 1979) suggests that the excess availability of the major divalent cations in these soils (Ca++ and Mg++ primarily) will produce a discrimination against uptake of Ra++ in the clay soils containing higher than normal Ra-226. However, additional research is required to further define the full extent of the potential hazards. It should be

Table 3-9. SUMMARY OF RADON-222 FLUX CHARACTERISTICS OF VARIOUS LAND TYPES IN POLK COUNTY, FLORIDA.

Land Types	Number of Sites	Radon-222 Flux, pCi/m^2s	
		Mean	Range
Unaltered	17	0.2	0.1 - 1.7
Unmined Radioactive Fill	2	1.3	0.6 - 2.8
Tailings	19	0.7	0.1 - 2.7
All Overburden	27	1.5	0.1 -12.8
Capped and Mixed Clays	6	1.6	0.3 - 7.2
Uncapped Clays	2	4.4	3.6 - 5.4
Debris	15	4.2	1.7 -13.7

Source: Roessler, et al. (1978).

noted that current fertilizer products such as TSP may contain up to 32 pCi/g Ra-226. Thus, the direct application of fertilizer products to crops may be of more concern than the direct uptake from the reclaimed soils.

Should buildings (such as residences) be located on the reclaimed site, indoor radon and radon progeny concentrations would be higher in these structures than outdoors. For any homes that are constructed, the predicted indoor radon progeny (WL) could range from 0.011 over reclaimed sand tailings to 0.018 WL over reclaimed clay settling areas. The value for homes over sand-clay mix areas would be 0.013 WL. Slab-on-grade structures in Polk County over undisturbed lands have WLs ranging from 0.001 to 0.010, with a geometric mean of 0.003. Two standards for WL in existing homes have been proposed: (1) a 0.029 WL total exposure including background (Florida Department of Health and Rehabilitation Services 1978) and (2) a 0.020 WL total exposure including background (EPA 1979b). The reclamation processes and undeveloped lands were not addressed in detail in EPA's 1979 recommendations to the Governor of Florida (EPA 1979b). However, the following specific guidance was provided for new homes on any reclaimed, debris, and unmined lands which contain phosphate resources:

> "IV. Development sites for new residences should be selected and prepared, and the residences so designed and sited, that the annual average indoor ...." Working Levels " ...do not exceed .... background levels...." (EPA 1979b)

If the final guidance for reclaimed lands is similar to the recommendation quoted above, then the upper limit of predicted WLs in slab-on-grade homes will be approximately 0.009 WL (normal background of 0.004 WL plus the uncertainty of 0.005 WL). Overall, the reclaimed Farmland site will slightly exceed this upper range. However, Farmland's reclamation plan does not include plans for residential development. If residences were planned they would have to be designed so as to prohibit the accumulation of radon progeny to levels above the .009 WL limit.

Conventional Reclamation. Reclamation as conventionally practiced in the Florida phosphate industry would increase the area of the site with exposed soils having Ra-226 concentrations on the order of 6.1 pCi/g. Under Farmland's proposed plan, the extent of such areas would be 583 acres. Using conventional methods, this acreage would increase to about 2500 acres.

Natural Mine Cut Reclamation. Natural mine cut reclamation differs from both Farmland's proposed reclamation plan and conventional reclamation in that the overburden windrows created by the mining operation would not be graded and reclaimed as pasture. Because of the irregular topography created by natural mine cut reclamation, much of the site would not be suitable for residential or agricultural use. Thus, the pathways to the human environment would be eliminated. The areas used for disposal of waste clays could be utilized for pasture and would thus be a potential source of uptake. The natural systems that would develop over most of the site would also tend to retain radioactive species.

3.4 GROUNDWATER

3.4.1 THE AFFECTED ENVIRONMENT

3.4.1.1 Groundwater Quantity

Three aquifers underlie the Farmland site--the Surficial Aquifer, the Secondary Artesian Aquifer, and the Floridan Aquifer (Figure 3-4). The Surficial Aquifer extends to the land surface and consists of about 60 ft of sand and sandy clay. Relatively impermeable portions of the matrix (phosphate bearing zone) at the base of the surficial deposits separate the Surficial Aquifer from the underlying Secondary Artesian Aquifer. The Secondary Artesian Aquifer consists of about 230 ft of dolomitic limestone, sandy clay, and small amounts of chert. There is a relatively impermeable clay bed at the base of the Secondary Artesian Aquifer. This is considered to be a leaky confining bed separating it from the underlying Floridan Aquifer. The Floridan Aquifer includes a thick series of permeable beds of limestone.

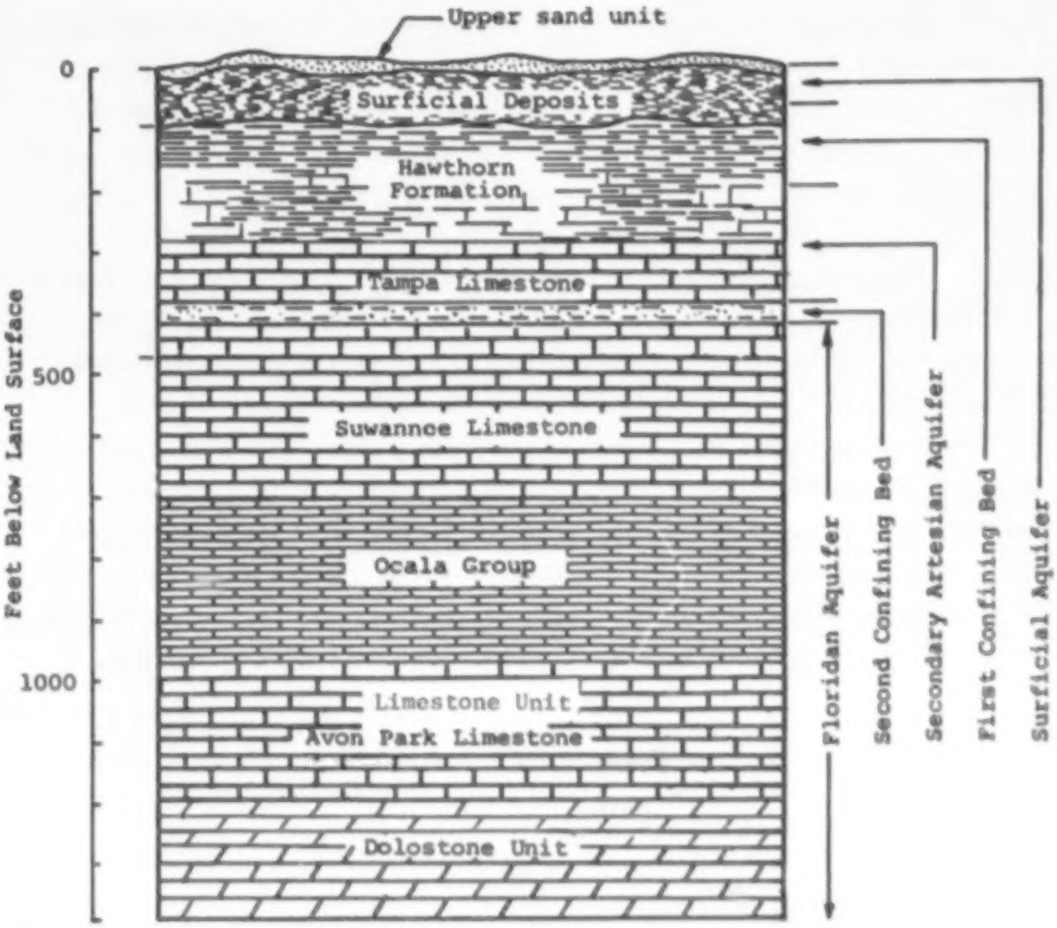


FIGURE 3-4. HYDROGEOLOGICAL CROSS SECTION OF THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

3.4.1.1.1 Surficial Aquifer

The level of the water table in the Surficial Aquifer varies in response to changes in rainfall, evapotranspiration, baseflow support to streams, and leakage into the underlying Secondary Artesian Aquifer. When measured between May 1977 and August 1978, the water levels varied from 10.0 ft below to 0.84 ft above the ground surface. Because the ground surface varies between 35 and 100 ft, the water table elevation is also variable. Water levels have been periodically monitored since November 1975 in piezometers on the Farmland property (P.E. LaMoreaux & Associates, Inc. [PELA] 1978) and on Mississippi Chemical Corporation (MCC) property, just north of the Farmland site (PELA 1977). These data indicate that the water table generally reaches a seasonal low in May and highs between June and September (Figure 3-5). The dry season decline in water table under the mine site was measured to be 2 to 8 ft in 1978. The greatest seasonal water level fluctuations appear to occur where the percentage of sand is greatest.

The average value of transmissivity obtained from two pumping tests was 11,200 gallons per day per foot (gpd/ft) (PELA 1979). The average values of specific yield at Farmland are as follows:

Aquifer Thickness (ft)	Transmissivity (gpd/ft)	Specific Yield or Storage
60	11,400	14

The average values of specific yield at Farmland are approximately ten times the specific yield obtained by MCC in tests on adjoining property (MCC 1976). Values of the in-situ horizontal permeability obtained from 20 recovery tests averaged 1.5 X 10^{-3} cm/sec (32 gpd/ft^2) for silty fine sands and 1.2 X 10^{-5} cm/sec (0.25 gpd/ft^2) for clayey sands. Laboratory values for vertical and remolded permeability ranged from 3 X 10^{-4} to 9 X 10^{-3} cm/sec (6.4 to 190 gpd/ft^2) for silty fine sands and from 1 X 10^{-6} to 1 X 10^{-5} cm/sec (0.021 to 0.21 gpd/ft^2) for clayey sands (Ardaman & Associates, Inc. 1980).

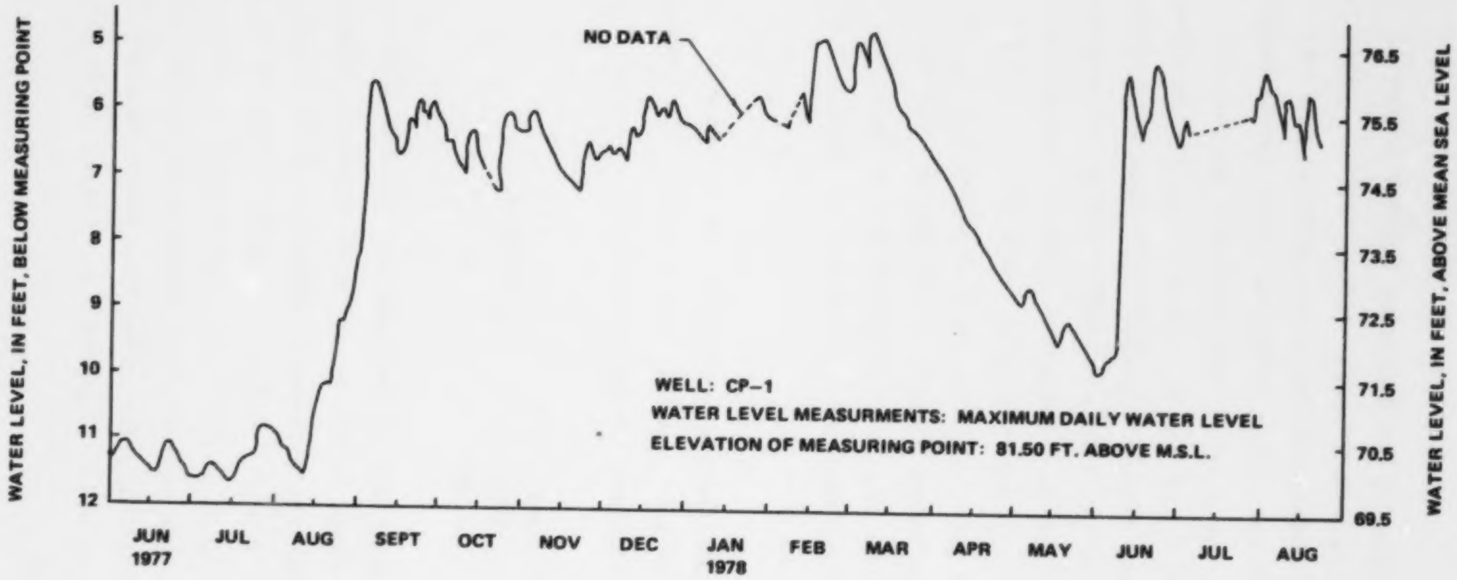


FIGURE 3-5. HYDROGRAPH OF SURFICIAL AQUIFER WELL CP-1 ON THE FARMLAND INDUSTRIES, INC. MINE SITE; JUNE 1977- AUGUST 1978.

SOURCE: P.E. LA MOREAUX & ASSOCIATES, INC. (1978)

Wells in the Surficial Aquifer yield up to 200 gpm in some areas and are widely used as a water supply. There are approximately 20 domestic wells and a number of small diameter irrigation and stock wells completed in the Surficial Aquifer within 1 mile of the Farmland property.

3.4.1.1.2 Secondary Artesian Aquifer

The Secondary Artesian Aquifer includes the Hawthorn Formation and the Tampa Limestone (Figure 3-4). The top of the Secondary Artesian Aquifer conforms generally to the top of the bedrock and is about 60 ft below the surface of the property. A 10 to 20 ft thick bed of clay at the base of the Tampa Limestone located approximately 600 ft below the ground surface separates the Secondary Artesian Aquifer from the underlying Floridan Aquifer.

Because the confining beds of the Secondary Artesian Aquifer are not completely impermeable, local leakage occurs from both the Surficial Aquifer and the underlying Floridan Aquifer. Due to the head difference of 25 to 40 ft, the Farmland property may be an area of recharge from the Surficial Aquifer to the underlying Secondary Artesian Aquifer. The upper confining layer is more than 100 ft thick in some areas of the mine site and has an estimated leakance of 1×10^{-4} gpd/ft^3 (Ardaman & Associates, Inc. 1980).

The head in the Secondary Artesian Aquifer in the vicinity of the Farmland property was found to vary seasonally from 2.5 ft above to 1.0 ft below the head in the Floridan (PELA 1979). Pumping tests on the Floridan Aquifer at the mine site indicate a leakance of 2.4×10^{-3} gpd/ft^3 (PELA 1979). Upward leakage may occur from the deeper Floridan Aquifer when the potentiometric surface of the Floridan is higher than that of the Secondary Artesian Aquifer.

During the period of record, the water level in one well in the Secondary Artesian Aquifer attained a high level of 52.40 ft above mean sea level (MSL) and a low level of 29.80 ft MSL. Seasonal variation is generally similar to that in the underlying Floridan Aquifer (Figures 3-6 and 3-7).

One pumping test was conducted on the Secondary Artesian Aquifer on the Farmland property (PELA 1979) and a transmissivity value of 43,300 gpd/ft was obtained. The average values of specific yield at Farmland are as follows:

Aquifer Thickness (ft)	Transmissivity (gpd/ft)	Specific Yield or Storage	Leakance (gpd/ft^3)
500	43,300	2.52×10^{-4}	0

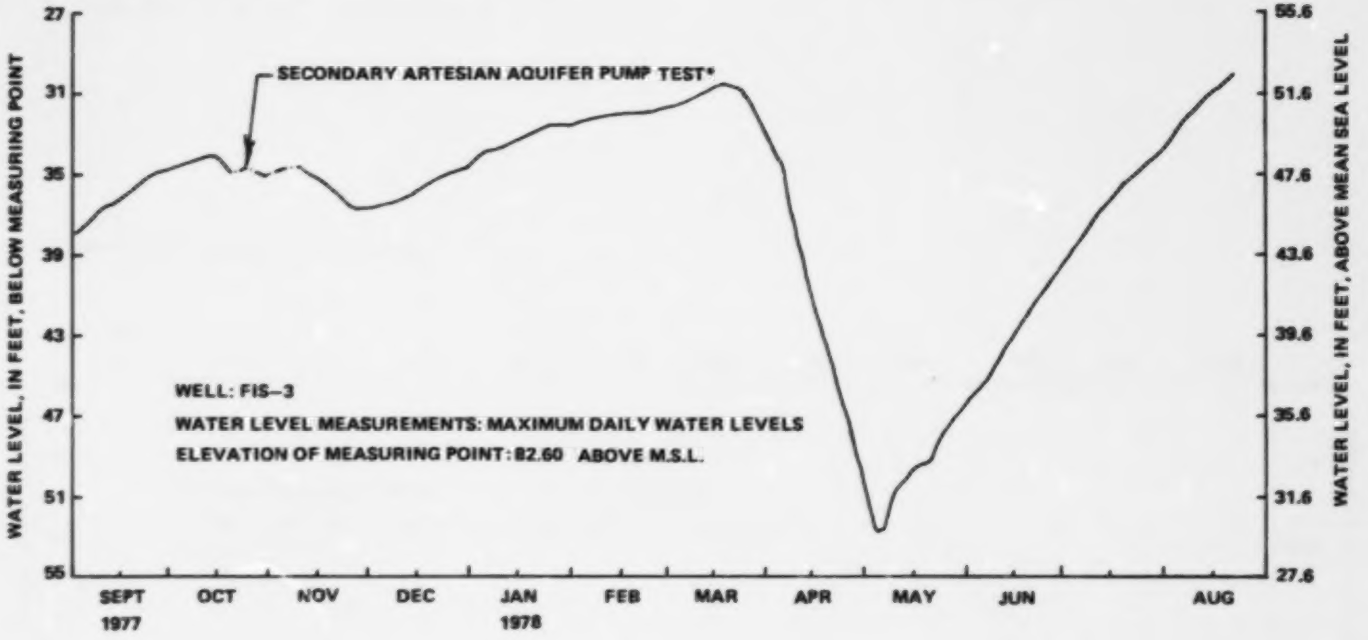
The values of storativity are one to two orders of magnitude smaller than those obtained at the MCC property (MCC 1976).

The in-situ horizontal permeability was determined to be between $1.0 \text{ X } 10^{-3}$ and $2.5 \text{ X } 10^{-3}$ cm/sec for indurated calcareous clays and limestone. Values for in-situ horizontal permeability of clayey sands and clays ranged between $3.0 \text{ X } 10^{-3}$ and $1.6 \text{ X } 10^{-4}$ cm/sec (Ardaman & Associates, Inc. 1980). Vertical permeabilities obtained from laboratory tests ranged from $1.0 \text{ X } 10^{-7}$ to $5.2 \text{ X } 10^{-7}$ cm/sec for indurated calcareous clays and limestone and from $1.7 \text{ X } 10^{-9}$ to $2.8 \text{ X } 10^{-8}$ cm/sec for clays (Ardaman & Associates, Inc. 1980).

Wells in the Secondary Artesian Aquifer yield as much as 1000 gpm in the vicinity of the proposed mine. There are only a few wells in the vicinity of the Farmland property that are completed solely in the Secondary Artesian Aquifer.

3.4.1.1.3 Floridan Aquifer

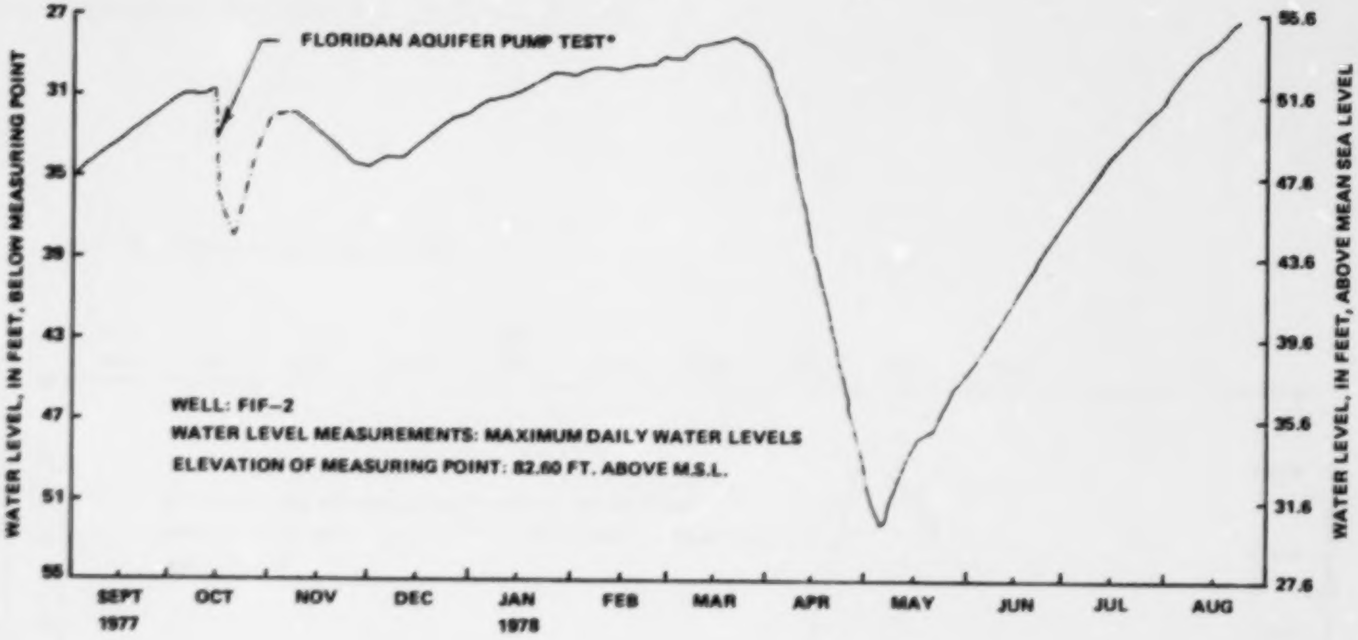
The Floridan Aquifer is the primary source of water supply for Hardee County and much of Florida. Yields of 5000 gpm per well are common. There are a large number of high yielding irrigation wells completed in the Floridan Aquifer in the immediate vicinity of the Farmland property.



* WELL LOCATED 50 FT FROM PUMPED WELL

FIGURE 3-6. HYDROGRAPH OF SECONDARY ARTESIAN AQUIFER WELL FIS-3 ON THE FARMLAND INDUSTRIES, INC. MINE SITE; SEPTEMBER 1977- AUGUST 1978.

SOURCE: P.E. LA MOREAUX & ASSOCIATES, INC. (1978)



WELL: FIF–2
WATER LEVEL MEASUREMENTS: MAXIMUM DAILY WATER LEVELS
ELEVATION OF MEASURING POINT: 82.60 FT. ABOVE M.S.L.

* WELL LOCATED 100 FT FROM PUMPED WELL

FIGURE 3-7. HYDROGRAPH OF FLORIDAN AQUIFER WELL FIF-2 ON THE FARMLAND INDUSTRIES, INC. MINE SITE; SEPTEMBER 1977- AUGUST 1978.

SOURCE: P.E. LA MOREAUX & ASSOCIATES, INC. (1978)

From top to bottom the Floridan Aquifer includes the Suwannee Limestone, the Ocala Group and the Avon Park Limestone (Figure 3-4). All three units consist of limestones, dolomitic limestones or dolostones. The Suwannee comprises the upper 250 ft of the Floridan Aquifer. The most prolific water producing unit is the Avon Park Limestone which extends from 980 to 1600 or 1700 ft below ground surface. Its lowest stratum is a relatively impermeable evaporite. Many of the wells drilled in the area near the Farmland property penetrate fractured and cavernous zones in the Avon Park Limestone, but no significant cavernous zones were encountered in the wells drilled on the Farmland site.

The relatively impermeable evaporite stratum at the base of the Avon Park Limestone is underlain by the Lake Creek Limestone which has a very low transmissivity (PELA 1977). Thus, an impermeable zone which would prevent or greatly retard the upward movement of water separates the freshwater in the Floridan Aquifer from the highly mineralized water found in underlying rock. The saltwater/freshwater interface calculated by using the Ghyben-Herzberg principal (Stringfield 1966) for conditions at the Farmland mine site in March 1978 was about 2100 ft below MSL.

Elevations of the piezometric head in the Floridan Aquifer beneath the Farmland property varied between 28 and 53 ft MSL when measured from September 1977 through May 1978. The head in the Floridan tends to vary seasonally and was observed to be approximately the same as the head in the Secondary Artesian Aquifer (Figures 3-6 and 3-7).

One pumping test of the Floridan Aquifer was conducted on the Farmland property. The water levels in the wells offsite were not noticeably affected. The average value obtained for the transmissivity of the Floridan Aquifer at the Farmland site was 528,000 gpd/ft, which is about one-half that obtained at the MCC site. This difference could be due to the aquifer having better developed cavities at the MCC site than at the Farmland site. The average storativity values for both sites were as follows:

Aquifer Thickness (ft)	Transmissivity (gpd/ft)	Specific Yield or Storage	Leakance (gpd/ft^3)
950	528,000	2.5×10^{-3}	2.3×10^{-3}

A leakance of 2.3×10^{-3} gpd/ft was measured at the Farmland site, but no leakage was detected with the MCC test. Since the nearest outcrop to the Floridan is more than 100 miles away from the proposed mine, any recharge to the Floridan Aquifer is from leakage.

There are currently nine wells on Farmland property that pump water for irrigation from the Floridan Aquifer. All of the pumping occurs during the dry season, which is also the time that the potentiometric surfaces of the artesian aquifers are at the lowest levels. Calculated drawdowns at the boundaries of the Farmland property resulting from pumping these irrigation wells range from 1 to 5 ft.

3.4.1.2 Groundwater Quality

The quality of the underlying groundwaters is generally good, with only a few parameters exhibiting high enough concentrations to warrant concern from a public health standpoint. But primarily because of the effects of local geology, the water in each of the three aquifer systems has a distinctive chemical character.

3.4.1.2.1 Surficial Aquifer

A summary of Surficial Aquifer water quality data for two wells on the Farmland mine site is presented in Table 3-10. Concentrations of almost all constituents measured are within the Florida water quality standards, the exception being the Florida gross alpha standard (15 pCi/l), which was consistently exceeded.

3.4.1.2.2 Secondary Artesian Aquifer

The overall quality of the groundwater in the Secondary Artesian Aquifer (Table 3-11) is lower than that in the Surficial Aquifer, which

Table 3-10. STATISTICAL SUMMARY OF GROUNDWATER QUALITY DATA FOR SELECTED WELLS IN THE SURFICIAL AQUIFER ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

Parameter[1]	PT-1[3]				PT-2[3]			
	$\bar{x}$[2]	S.D.	Min.	Max.	$\bar{x}$	S.D.	Min.	Max.
Temperature (°C)	22.5	1.2	20.5	24.6	24.5	1.6	22.3	27.5
pH (std. units)	5.5	0.2	5.07	5.9	5.6	0.3	5.1	6.3
Conductivity (μmhos/cm)	101	29	70	155	95	18	73	124
Total Dissolved Solids	67	19	36	104	60	12	45	93
Total Suspended Solids	14	20	1.0	73	7	9	1.7	38
Total Alkalinity as $CaCO_3$	33	26	12	111	17	8.5	3.7	31
Total Hardness as $CaCO_3$	44	15	28	72	38	7	28	50
Calcium	11	3	6.9	16	8.9	1.8	7.0	12
Magnesium	3.7	1.7	1.9	7.1	2.9	1.0	1.6	4.7
Sodium	4.9	0.7	4.3	7.0	6.1	4.5	4.3	21
Potassium	0.42	0.24	0.29	1.20	0.60	0.22	0.35	1.19
Iron	1.16	0.42	0.13	2.00	2.04	0.64	0.24	2.79
Silica	2.7	0.6	1.8	4.2	4.6	1.1	3.0	7.0
Sulfate	3.6	1.4	2.2	6.8	11	2.5	7.4	17
Chloride	13	8.4	9.2	42	11	1.9	8.5	14
Fluoride	0.34	0.12	0.02	0.47	0.40	0.17	0.02	0.60
Bicarbonate	42	32	21	136	22	11	4.5	38
Nitrate	0.26	0.36	<0.01	1.34	0.14	0.14	0.01	0.51
Phosphate	1.21	0.95	<0.01	4.27	0.53	0.22	0.06	0.80
Hydrogen Sulfide	0.49	0.16	0.10	0.72	0.28	0.19	0.10	0.70
Radium-226 (pCi/l)	0.5	0.4	0.1	1.1	0.5	0.1	0.3	0.6
Gross Alpha (pCi/l)								
Dissolved	43.4	26.7	6.6	81.6	69.3	37.3	19.7	115.4
Suspended	3.7	2.7	1.8	8.4	3.8	2.1	2.1	7.3

[1] All units in mg/l unless otherwise noted.

[2] Abbreviations: $\bar{x}$ = mean; S.D. - standard deviation; Min. = minimum value determined;
Max. = maximum value determined.

[3] Data for PT-1 and PT-2 are based on 14 monthly samples between June 1977 and July 1978.

Table 3-11. ANALYSES OF GROUNDWATER FROM THE SECONDARY ARTESIAN AND FLORIDAN AQUIFERS ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

Parameters[1]	Secondary Artesian Aquifer (FIS-1)		Floridan Aquifer (FIF-1)			
Sampling Date:	7/12/77	7/15/77	10/4/77	10/14/77	10/21/77	10/24/77
Temperature (°C)	26.0	25.5	30.2	29.2	-	29.5
pH (std. units)	7.62	2.5	7.2	7.3	-	7.5
Conductivity (μmhos/cm)	465	460	570	580	580	590
Total Dissolved Solids	307	319	371	366	371	370
Total Suspended Solids	87	5.0	0.0	0.0	0.0	0.0
Total Alkalinity as $CaCO_3$	174	152	136	147	148	147
Total Hardness as $CaCO_3$	206	200	246	252	249	247
Calcium	41	39	51	58	57	56
Magnesium	25	25	29	26	26	26
Sodium	27	25.7	9.2	9.0	9.2	9.2
Potassium	3.0	3.0	0.19	1.99	2.02	2.03
Iron	0.26	0.07	0.03	0.02	0.01	<0.01
Silica	23	18	10	9.0	10	10
Sulfate	45	45	100	100	100	100
Chloride	21.3	20.7	11	11	11	12
Fluoride	3.0	2.8	0.25	0.25	0.25	0.25
Bicarbonate	212	185	165	179	180	179
Nitrate	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phosphate	0.136	0.03	<0.01	<0.01	<0.01	<0.02
Hydrogen Sulfide	1.20	1.64	2.9	3.2	3.1	3.1
Radium-226 (pci/1)[2]	16.0(7/77)	15.2(2/78)	6.7(10/77)	2.5(10/77)	1.9(2/78)	13.9(7/78)
Gross Alpha (pCi/1)[2]						
Dissolved	11.1(7/77)	12.1(2/78)	<3.7(7/77)	<2.6(10/77)	<1.0(2/78)	9.3(7/78
Suspended	6.2(7/77)	<3.5(2/78)	<3.1(7/77)	<1.0(10/77)	<2.6(2/78)	<6.0(7/78)

[1] All units in mg/1 unless otherwise noted.

[2] Radiologic samples were taken on dates shown in parentheses.

Source: P.E. LaMoreaux & Associates, Inc. (1978).

is not surprising considering its longer contact time with local geological strata. The Secondary Artesian waters generally have higher concentrations of silica, sulfate, fluoride, magnesium, calcium, bicarbonate, and potassium, and lower concentrations of iron, nitrate, and phosphate, than surficial groundwaters near the mine site. Ra-226 concentrations (on the order of 15-16 pCi/l) were found to be much higher in the Secondary Artesian Aquifer than in the Surficial Aquifer (0.5 pCi/l). The concentrations found exceed the Florida standard for Ra-226/Ra-228 and fluoride.

3.4.1.2.3 Floridan Aquifer

The quality of the groundwater in the Floridan Aquifer is in some cases poorer than that found in the Secondary Artesian Aquifer (Table 3-11). Water from the Floridan Aquifer has greater concentrations of calcium and sulfate, but smaller concentrations of sodium, potassium, iron, silica, chloride, fluoride, and bicarbonate. Relatively high concentrations of hydrogen sulfide were also found in water samples from this aquifer. The Florida standard for Ra-226/Ra-228 was exceeded on two sampling dates (6.7 pCi/l on one date and 13.9 pCi/l on another date). However, these levels are generally lower than were found in samples from the Secondary Artesian Aquifer.

3.4.2 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

3.4.2.1 The No Action Alternative

Under the no action alternative no appreciable changes in the existing quantities of groundwater are anticipated. The present seasonal changes in water levels in the Surficial, Secondary Artesian, and Floridan Aquifers will not be affected. The seasonal pumping of the Floridan Aquifer by the nine onsite high-capacity irrigation wells will continue, as will their resultant drawdowns. This alternative will also cause no changes in the hydrologic characteristics of the Surficial Aquifer or change in rate of baseflow to the local surface water courses.

Groundwater quality under the no action alternative will depend on the future uses for land in the area. If land use patterns in the immediate area remain fairly constant over the next few decades, groundwater quality should remain much as it is today.

3.4.2.2 The Action Alternatives, Including The Proposed Action

3.4.2.2.1 Mining

Dragline Mining (Farmland's Proposed Action). The impacts of dragline mining on groundwater quantity will be associated primarily with the Surficial Aquifer as a result of dewatering of mine pits. Water seeping into mine pits will be collected and added to the recirculating production water supply. Seepage into pits will vary from one area to the next depending on the length of the mine cut, but will average about 500 gpm (Farmland 1979b). Where pits are adjacent to existing streams, the pits will induce infiltration from the streams--increasing pit seepage and causing some decrease in streamflow until the pit dewatering ceases.

Under Southwest Florida Water Management District (SWFWMD) regulations the water table should not be lowered by more than 3 ft at the property boundaries. In order to prevent this from occurring, Farmland proposes to construct rim ditches between the mine pits and adjacent property boundaries in areas where water table decreases could be significant. These will be kept filled with water. Seepage into the ground will help maintain the water table level beneath the neighboring property.

Dragline mining should not result in any significant changes in groundwater quality.

Dredge Mining. Use of dredge mining would maintain water levels in the surrounding Surficial Aquifer; however, increased pumping of the Floridan Aquifer would be required to maintain water levels in the dredged pits during dry seasons. This added pumping of the Floridan Aquifer would cause increased declines in the piezometric head in the Floridan Aquifer.

The water contained within the active mining area would likely be turbid and contain higher concentrations of some parameters than water in the adjacent undisturbed Surficial Aquifer. At times when the level of the Surficial Aquifer is below the water level in the active mining area, some of this water could move laterally and degrade its quality. However, the resultant impacts on groundwater quality in the area should be insignificant.

Bucketwheel Mining. The impacts of bucketwheel mining on groundwater quantity would be similar to those described for dragline mining.

Bucketwheel mining should not result in any significant changes in groundwater quality.

3.4.2.2.2 Matrix Transport

Slurry Matrix Transport (Farmland's Proposed Action). Farmland proposes to pump matrix from the active mining area to the beneficiation plant as a water slurry. The water used in this process (about 25,500 gpm) will be recycled water from the washer plant rather than fresh water. The only fresh water required (about 250 gpm, or .36 mgd) is that needed for use as seal water in the pumps themselves. The seal water will be obtained from shallow wells into the Surficial Aquifer.

Conveyor Matrix Transport. Conveyor matrix transport would involve the placement of matrix onto a belt conveyor at the active mining area for transport to the beneficiation plant without the use of water. While it would appear that this would eliminate the need for large quantities of water involved in slurry transport, there is actually little difference in the overall operational water needs. This is because a similar amount of water to that used in slurry pumping would have to be added to the conveyored matrix once it reached the plant to initiate processing. The need for pumps, and thus the 250 gpm of pump seal water, would be eliminated--the actual net difference.

Truck Matrix Transport. As in the case of conveyor matrix transport, truck matrix transport would eliminate the need for pump seal water from the Surficial Aquifer (250 gpm). However, it would likely be necessary to apply water to haul roads, etc. to reduce fugitive particulate levels.

3.4.2.2.3 Matrix Processing

Conventional Matrix Processing (Farmland's Proposed Action). Conventional matrix processing requires that groundwater be used in combination with flotation reagents to separate the various fractions of the matrix. Under normal operating conditions, groundwater will be pumped at a rate of 8.8 MGD from the Floridan Aquifer. Figure 3-8 presents the projected drawdown which this withdrawal would produce. The contours shown in this figure were generated using the Trescott finite difference model (Trescott 1973) and pump test data acquired for Farmland's Consumptive Use Permit Application, administered by the SWFWMD. As presented, the drawdown contours represented are the result of withdrawals from a single well located at the beneficiation plant. Farmland plans to evaluate the effects of the Floridan pumping in more detail with SWFWMD so that all drawdown regulations enforced by SWFWMD can be met (i.e., no more than 5 ft at the property boundary, unless a variance is granted). The Trescott model predicts a maximum steady state drawdown of about 31 ft. This may require that pumping be halted temporarily during dry periods in order to prevent the potentiometric surface from dropping below sea level--violating SWFWMD regulations.

All the impacts to potentiometric surface in the Floridan Aquifer are expected to be temporary. The potentiometric level is expected to recover once pumping is ended, in much the same way that the aquifer recovers from the irrigation pumping each year.

The elevation of the saltwater-freshwater interface below the site was determined using the Ghyben-Herzberg principle. Its location was estimated to be 2100 ft below MSL in March 1978. The great distances to

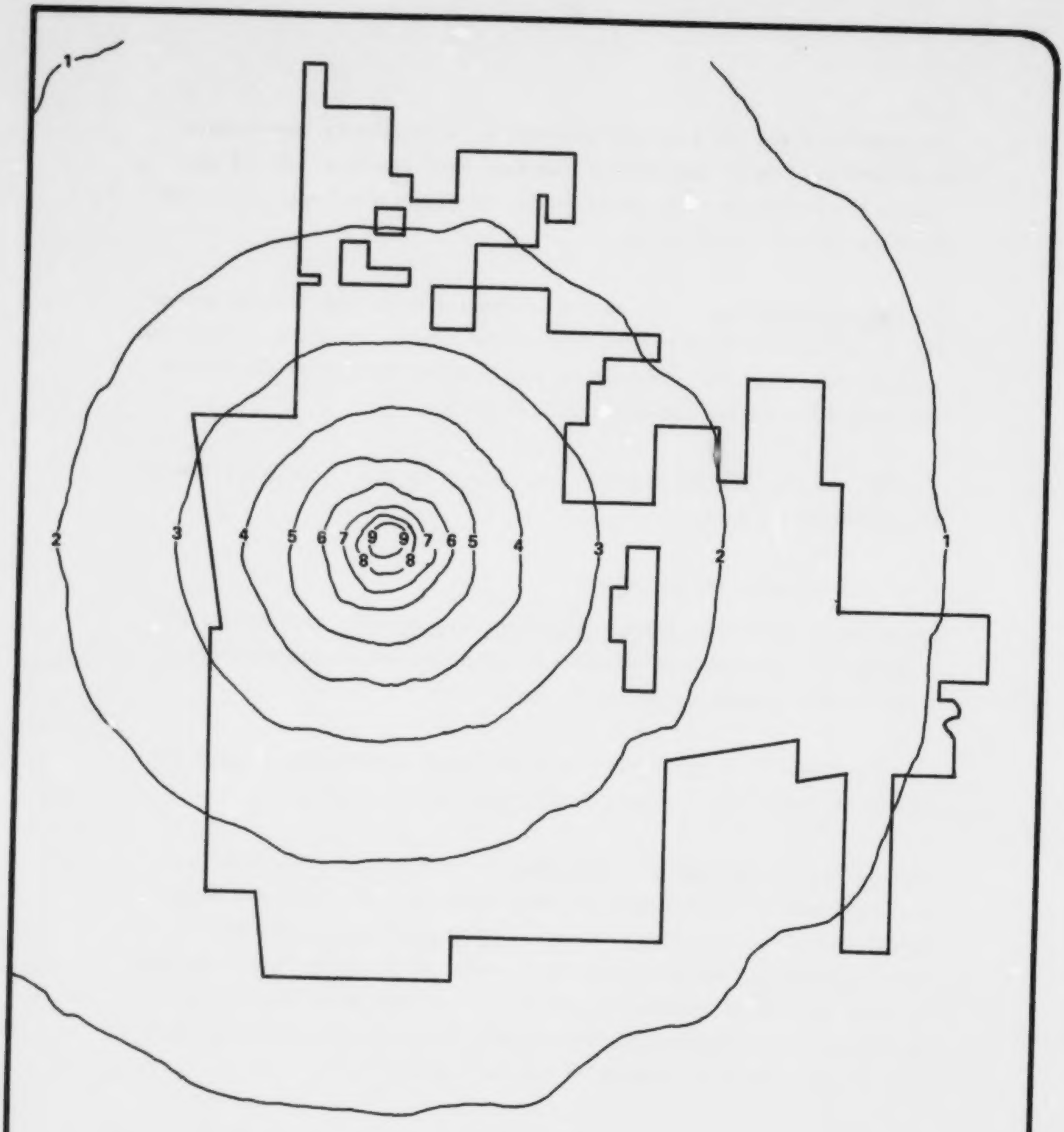


FIGURE 3-8. FLORIDAN AQUIFER DRAWDOWN PROJECTION FOR THE PRODUCTION WELL LOCATED AT THE FARMLAND INDUSTRIES, INC. PLANT SITE; PUMPING RATE 6200 GPM.

SOURCE: ADAPTED FROM DATA PROVIDED BY FARMLAND INDUSTRIES, INC.

the interface and the probable presence of a relatively impermeable evaporite stratum at the base of the Avon Park Limestone should substantially prevent the upward migration of mineralized water into the Floridan Aquifer (PELA 1979b).

Dry Matrix Processing. Dry matrix processing would involve the use of air and/or electrostatic separation of the matrix fractions. Thus, the drop in the potentiometric head of the Floridan Aquifer predicted for the pumping discussed above should not occur.

Dry matrix processing should not result in any significant changes in groundwater quality.

3.4.2.2.4 Process Water Sources

Groundwater Withdrawal (Farmland's Proposed Action). The impacts of groundwater withdrawal on groundwater quantity are discussed under "Conventional Matrix Processing", above.

The impacts of groundwater withdrawal on groundwater quality are discussed under "Conventional Matrix Processing", above.

Surface Water Impoundment. Impounded surface waters collected from above average flows of onsite streams would provide a process water source capable of satisfying all project requirements. Therefore, surface water impoundment should not result in any significant changes in deep (Floridan) groundwater quantity. Surface water impoundment would also help maintain the water table height in the Surficial Aquifer, at least in the vicinity of the impoundment.

Because such impounded surface waters would provide a process water source capable of satisfying all project requirements, surface water impoundment should not result in any significant changes in deep (Floridan) groundwater quality.

3.4.2.2.5 Waste Sand and Clay Disposal

Sand-Clay Mixing (Farmland's Proposed Action). Farmland proposes to dispose of most of the waste sand and clay from the beneficiation plant in the form of a sand-clay mix. This material will be placed into mined areas once space becomes available. Separate sand and clay disposal areas will also be required during the life of the mine. Disposal of waste clay in a separate impoundment (Area I, 495 acres) during the initial years of operation is required because sufficient mined area will not be available for sand-clay mix disposal. During following years, a separate disposal area (Area II, 583 acres) is required to control the ratio of sand:clay in the mix used to fill mined areas. In order to make the initial settling pond (Area I) functional, it will be filled with water from the Floridan Aquifer prior to operation. This will require the withdrawal of about 8.8 mgd over a period of about 1 year. This withdrawal of water from the Floridan Aquifer will produce a drawdown similar to that which will occur during normal operations (Figure 3-8). Area II will be filled with water from the recirculating water system and thus should not result in any additional impacts on groundwater quantity.

Much of the water withdrawn during normal operations (about 8.8 mgd) will be entrained within the waste disposal areas. During the initial years of operation (when waste sand and clay are disposed of separately) this will amount to about 4.5 mgd. It is anticipated that this loss of water through entrainment will be reduced when sand-clay mixing is used, but the actual degree of success for water recovery is not known at this time.

Farmland's proposed waste disposal plan will also affect the quantity of water in the Surficial Aquifer, for some of the water used to transport waste sand and clay and from the ditches and ponds comprising the water recirculation system will seep into the Surficial Aquifer. Under average annual conditions, this should amount to about 4.5 mgd (Farmland 1979a; 1979b).

As indicated above, some of the water used to transport these wastes would seep into the Surficial Aquifer. This water, if contaminated during use, could move laterally and degrade the quality of the Surficial Aquifer in adjacent areas. Ardaman (1980) reports that the coefficient of horizontal permeability for the Surficial Aquifer is on the order of 5.0×10^{-3} cm/sec, or about 15 ft/day.

One way to characterize the water quality effects of mixing mine and beneficiation plant water with Surficial groundwaters is to compare existing characterizations of such waters from other mining operations with the quality of Surficial Aquifer waters. This comparison is made in Table 3-12. The slime supernatant water is the average of analyses from 15 beneficiation plants in Florida. According to this comparison, Surficial Aquifer water quality would be degraded in a localized area around the sand-clay mixtures. Concentrations of most constituents would increase in the area near the reclamation sites. While the concentrations of a number of constituents would increase, available data do not indicate water quality standards would be exceeded. Concentrations of fluoride in the slime supernatant exceed the 1.5 mg/l groundwater standard for Florida by about 33 percent. It is expected that available mixing would lead to fluoride concentrations below the standard within a short distance from the reclamation activities. Ra-226 concentrations are not expected to rise significantly above background levels.

Conventional Sand and Clay Disposal. In conventional sand and clay disposal, all of the waste sand and clay generated by the beneficiation plant would be disposed of in separate areas--that used for clay disposal totaling about 2500 acres. Such areas would, as described for Farmland's proposed action, be a source of seepage to the Surficial Aquifer. However, the settled clays may form more of a natural "liner" than sand-clay mix will, significantly reducing such movement.

The increased entrainment of water by the separately impounded clays over the life of the mine would increase the amount of water

Table 3-12. COMPARISON OF THE WATER QUALITY OF SURFICIAL AQUIFER WATER AND SURFACE WATER FROM THE FARMLAND INDUSTRIES, INC. MINE SITE TO MEASURED VALUES IN CLAY SETTLING AREA DISCHARGES.

Constituents[1]	Surficial Aquifer[2]	Surface Water[3]	Clay Settling Area Supernatant[4]
pH, pH units	5.6	6.4	7.8
Specific Conductance, µmhos/cm	98.	171.	523.
Total Dissolved Solids	64.	200.	348.
Calcium	10.	20.	57.
Magnesium	3.3	7.4	22.
Sodium	5.5	9.9	18.
Potassium	0.51	3.6	1.3
Bicarbonate	32.	39.	112.
Sulfate	7.3	19.	144.
Chloride	12.	29.	17.
Iron	1.6	0.76	0.119
Silica	3.7	8.2	2.5
Fluoride	0.37	0.20	2.0
Nitrate, as N	0.20	1.2	1.06
Phosphorus, as PO_4	0.87	1.62	0.273
Radium-226, pCi/l	0.5	0.12	0.67

[1] Units are mg/l unless otherwise noted.

[2] Average of analyses from Troublesome, Hickory, and Oak Creeks (October 1979 and March 1980).

[3] Average of analyses from wells PT-1 and PT-2 (June 1977 to July 1978).

[4] Lamont, et al. 1975. Characterization Studies of Florida Phosphate Slimes.

Source: U.S. EPA. 1979. Development Document for Effluent Limitations Guidelines and Standards, Mineral Mining and Processing Industry, Point Source Category.

"lost" relative to sand-clay mixing. Data presented by Farmland (1979b) indicate that the loss incurred through such clay areas could be on the order of 4.5 mgd.

As stated above, the disposal of waste sand and clay in separate areas might provide for better containment of the water used for their transport. This would reduce seepage and thus the impacts on the quality of the Surficial Aquifer from that described above for Farmland's proposed plan.

3.4.2.2.6 Water Management Plan

Discharge to Surface Waters (Farmland's Proposed Action). A discharge to surface waters should not result in any significant changes in groundwater quantity or quality.

Connector Wells. Connector wells could be used to discharge uncontaminated water from the recirculating water system to the deep aquifers. This would to some degree offset the withdrawal of groundwater from the Floridan Aquifer for processing.

Disposal of collected surface water in deeper aquifers may improve water quality (in the aquifer) in terms of dissolved solids, but would probably degrade groundwater quality in terms of other constituents such as fluoride, phosphate, and nitrate.

3.4.2.2.7 Reclamation

Farmland's Proposed Reclamation Plan. Farmland proposes to use a sand-clay mix for backfill over the majority of the mine site. The reclaimed land is expected to have lower hydraulic conductivities because of the higher clay content of the backfill material. Consequently, less seasonal fluctuation of the Surficial Aquifer level is expected in reclaimed areas than presently occurs in the unmined land. The decrease in head of the Surficial Aquifer may also act to reduce the movement of water from the Surficial to the Secondary Artesian Aquifer.

The water which comprises the "Surficial Aquifer" of the reclaimed mine site will most likely be of different quality than exists at present. The waste materials disposed of in mined areas will contain substantial amounts of reagents, etc. which may appear in water withdrawn from such areas in future years.

Conventional Reclamation. With conventional reclamation, much of the site (2500 acres) would be covered with impounded waste clays to a height of 35 ft above grade. These areas would be relatively impermeable and result in reduced water levels in the Surficial Aquifer. Those areas not covered with waste clays would be filled with overburden or sand tailings, or reclaimed as lakes. In these areas, the Surficial Aquifer would most likely reestablish to a greater degree than in areas covered by clays and perhaps even sand-clay mix.

The quality of the water within the reestablished Surficial Aquifer may also be higher using conventional reclamation methods. The reagents used in matrix processing would for the most part be contained by the waste clays in the separate disposal areas. Using sand-clay mix methods, those compounds may migrate from the waste clays and contaminate groundwater.

Natural Mine Cut Reclamation. The numerous water catchment areas (i.e., ungraded windrows) produced by natural mine cut reclamation would probably increase water levels in the Surficial Aquifer. However, this would occur at the expense of surface water flows from the site (see Section 3.5.2.2.7).

The quality of the water entering the Surficial Aquifer from mined areas could be of lower quality than for conventional reclamation because of the stagnation, etc., which could develop in isolated pools draining into the reclaimed surface. Such water would not, however, contain the quantities of reagents which could occur in water from sand-clay mix landfills.

3.5 SURFACE WATER

3.5.1 THE AFFECTED ENVIRONMENT

3.5.1.1 Surface Water Quantity

The Farmland mine site is located in an area typical of the Coastal Lowlands physiographical region. The site consists of nearly level plains, gently undulating to rolling areas with numerous swamps and marshes, and numerous intermittent and perennial streams. Sinkholes are common in the region, but no sinkholes or perennial lakes exist on the Farmland property. Elevations onsite range from 35 to 100 ft above MSL (PELA 1979).

The distribution and circulation of water in the atmosphere, on the land surface, and in the soil and underlying rocks of the Farmland site are typical of the Middle Gulf Hydrologic System as described by Cherry, et al. (1970). This well established hydrologic pattern is a result of the semi-tropical climatological regime, the very flat relief, the unconsolidated surficial deposits, and the limestone and dolomite geologic formations of the region. The frequent occurrence of rain storms in the summer months results in high stream discharges, and occasionally some local flooding. During the remainder of the year rains are usually less frequent and stream flows decrease, some streams go completely dry, and much of the flow in the others is baseflow that drains from the unconfined aquifer. The amount of baseflow ranges from 14 to 20 percent of the total yearly runoff.

Most of the mine site lies within portions of the drainage basins of Troublesome, Hickory, and Oak Creeks, which are all tributaries of the Peace River. The drainage divides are poorly defined and in some areas are overtopped during floods. About 4 percent of the site is adjacent to and drains directly into the Peace River. The pre-mining drainage areas and average annual flows are as follows:

	Area (acres)	Flow (cfs)
Troublesome	1,167	17.5
Hickory	2,261	6.9
Oak	4,055	15.8
Peace	250	--
Total	7,733	40.2

Each stream on the Farmland property was monitored between June 1977 and August 1978, and the streamflows were compared to the discharges at the U.S.G.S. gaging station on Horse Creek near Arcadia, Florida. Average streamflows for the streams on the site have been estimated based on these Horse Creek data (Table 3-13). All of the streams on the Farmland property, except Troublesome Creek, were observed to be dry during the spring and fall of 1977 and 1978. Their 2- and 10-year, 7-day low flow is zero. The low-flows estimated for Troublesome Creek are 0.4 cfs for the 2-year, 7-day low flow and 0.04 cfs for the 10-year, 7-day low flow.

Peak flow estimates for the streams on the Farmland property were made by applying drainage basin parameters of area, main channel slope, and storage to an equation developed from flow data collected from 15 gages streams comprising 439 station years of published peak flows in the Florida phosphate region. Peak flows were calculated for recurrence intervals of 2, 5, 25, and 100 years (PELA 1979) and are shown in Table 3-13.

3.5.1.2 Surface Water Quality

The Farmland site lies within the Peace River Basin. The water quality of the Peace River, as well as others in the region, is greatly influenced by flow--with higher dissolved solids and ionic concentrations occurring in the October-May dry period. The Peace River's flow

Table 3-13. AVERAGE AND FLOOD FLOWS OF STREAMS AT SELECTED SITES ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

Location	Drainage Area (Sq.Mi.)	Average Flow (cfs)	Flood Flows (cfs)			
			2-yr.	5-yr.	25-yr.	100-yr.
TROUBLESOME CREEK						
Inflow to property, Section 36	16.6	16.4	365	776	1680	2900
Outflow from property, Section 1	17.7	17.5	381	811	1750	3020
HICKORY CREEK						
Outflow of upper segment, Section 26	2.56	2.6	103	192	393	590
Inflow to property, Section 35	3.64	3.7	157	306	691	1012
0.67 mile from mouth	6.12	6.9	-*	-	-	-
OAK CREEK						
Inflow from upper Oak Creek below railroad, Section 9	10.6	10.2**	185	287	424	592
Section 11	15.5	14.9**	-	-	-	-
Outflow from property	16.4	15.8**	351	640	1188	19.0

*No Data.

**Based on total drainage with no adjustment for natural flood diversions to Brushy and Horse Creek.

Source: P.E. LaMoreaux & Associates, Inc. (1979).

is quite variable because of the relatively large contribution of overland runoff. Also affecting water quality in the Peace River are: (1) releases of pollutants into streams or lakes through point discharge; (2) failures of retaining dikes around treatment ponds; (3) overland runoff; and (4) inflow from contaminated aquifers hydraulically connected to the streams and lakes of the basin. Excessive concentrations of phosphates, fluorides, and nitrate and nitrite nitrogen are frequently found in Peace River Basin waters below the site. Excessive values have occasionally been measured for turbidity, ammonia nitrogen, and coliform bacteria. Phosphate mining activities in upstream areas account for phosphate and fluoride concentrations, while nitrogen concentrations may come from either point or non-point sources. Coliform bacteria come directly from sewage treatment plant discharges or from septic tank influence in the populated but unsewered areas.

Other affected watersheds included in the Peace River Basin are the Troublesome, Hickory, and Oak Creeks. A summary of surface water quality data from these watersheds is presented in Table 3-14. Surface water quality on and immediately adjacent to the site is generally good, although it does have a tendency to vary with time on a daily and seasonal basis. The primary causes of these observed variations appear to be related to several factors, of which stream discharge rates, biologic activity, and drainage basin land use seem to be the most important. Based on their dissolved salt content, these surface waters can be characterized as being similar to the waters of the Surficial Aquifer, a result that is not entirely unexpected considering the role of this aquifer in providing base flow to streams.

When the existing surface water conditions were examined for conformance with the Florida standards, the dissolved oxygen standard for Florida waters was found to be violated with greatest regularity. However, the cause of this violation is a naturally occurring phenomenon resulting from the structure of the biologic community occupying these waters. Similarly, occasional violations of the alkalinity, pH, fluoride, iron, and fecal coliform standards have occurred. For the most

Table 3-14. STATISTICAL SUMMARY OF SURFACE WATER QUALITY DATA FROM SELECTED STATIONS ON THE FARMLAND INDUSTRIES, INC. MINE PROPERTY; JUNE 1977 - JUNE 1978.

Parameter[1]	Peace River[3]				Troublesome Creek[4]				Hickory Creek[5]				Oak Creek[6]			
	$\bar{x}$[2]	S.D.	Min.	Max.	$\bar{x}$	S.D.	Min.	Max.	$\bar{x}$	S.D.	Min.	Max.	$\bar{x}$	S.D.	Min.	Max.
Discharge, cfs	-	-	-	-	48	162	0.0	771	53	130	0.0	540	104	330	0.0	1390
Conductivity, µmhos/cm	290	77	140	630	221	79	128	310	144	53	50	245	154	67	58	350
pH, std. units	6.4	0.6	5.4	7.6	6.6	0.6	5.5	7.5	6.3	0.7	4.4	7.8	6.2	0.6	4.8	7.0
Suspended solids	9	5	<5	22	7	3	<5	17	12	20	<5	116	19	23	<5	117
Total organic carbon	18.3	7.3	8.5	33.8	21.8	11.6	3.5	44.0	28	11	5.8	50	39.1	13.1	10.2	67.8
Dissolved oxygen	7.6	1.7	5.2	9.8	7.3	1.8	4.5	10.0	6.9	3.0	0.2	12.2	4.8	3.0	0.0	15.1
Biochemical oxygen demand (5-day)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrogen as N																
Nitrate/Nitrite	0.777	0.313	0.465	1.67	1.56	1.07	0.136	3.89	0.079	0.08	<0.004	0.293	0.115	0.326	<0.004	2.09
Ammonia	0.08	0.05	<0.03	0.23	0.06	0.03	<0.03	0.12	0.06	0.05	<0.03	0.22	0.08	0.08	<0.03	0.44
Organic	0.97	0.65	0.27	2.3	1.2	0.6	0.36	2.8	1.4	0.6	0.14	3.3	2.4	2.6	<0.02	14.9
Phosphate as P																
Ortho	2.30	0.71	1.41	3.79	0.602	0.164	0.265	0.89	0.65	0.26	0.323	1.3	0.75	0.52	0.223	3.50
Total	2.57	0.85	1.61	4.50	0.82	0.27	0.55	1.8	0.91	0.43	0.41	2.8	1.2	0.72	0.06	3.66
Dissolved silica	3.9	2.2	1.1	8.7	4.3	2.3	1.0	8.4	3.6	2.9	0.2	12.2	4.3	3.4	0.5	16.5
Fluoride	1.6	0.55	0.37	2.6	0.37	0.14	0.11	0.54	0.32	0.18	0.08	0.88	0.30	0.16	0.11	1.1
Iron	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fecal coliform (#/100ml)	180	260	<2	1200	640	1620	15	7600	740	1390	<2	7500	750	2500	<2	17,000

[1] All units in mg/l unless otherwise noted.

[2] Abbreviations: $\bar{x}$ = mean; S.D. = Standard Deviation; Min. = Minimum Value Determined; Max. = Maximum Value Determined.

[3] Stations SW-15 and SW-16 (24 samples between June 1977 to June 1978).

[4] Stations SW-11 and SW-12 (24 samples between June 1977 to June 1978).

[5] Stations SW-4, SW-9, SW-13, and SW-14 (42 samples between June 1977 to June 1978).

[6] Stations SW-2, SW-6, SW-7, and SW-8 (46 samples between June 1977 to June 1978).

Source: All data used in this analysis were as reported by P.E. LaMoreaux & Associates, Inc. (1978).

part, these conditions also appear to be a reflection of natural conditions in these waters. Limited analyses for radiochemical constituents failed to find detectable levels of total uranium, thorium-230, gross alpha, or gross beta. Ra-226 concentrations ranged from 0.0 to 0.38 pCi/l. The EPA standard for combined Ra-226 and Ra-228 concentrations is 5.0 pCi/l. Conformance with this standard cannot be determined from the available data, as concurrent Ra-228 analyses were not performed.

3.5.2 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

3.5.2.1 The No Action Alternative

Under the no action alternative no appreciable changes in the existing surface water quantity are anticipated. The present seasonal changes in streamflow will not be affected, flood flows will not be changed, nor will the extent of flooding. This alternative will also cause no change in the hydrologic characteristics of streams or change in rate of baseflow to them.

Surface water quality under the no action alternative will depend on the future uses for land in the area. If land use patterns in the immediate area remain fairly constant over the next few decades, surface water quality should remain much as it is today. If other phosphate mining and processing projects are permitted, selected stream waters may show increases in TDS, sulfate, phosphate, nitrogen, and fluorides. The amount of increase would depend upon the type of mining and chemical processing operations utilized in these facilities. Slight increases in radiological concentrations in surface waters may also be expected.

3.5.2.2 The Action Alternatives, Including the Proposed Action

3.5.2.2.1 Mining

Dragline Mining (Farmland's Proposed Action). Land clearing in preparation for mining will also increase surface water runoff from areas prior to mining, but because Farmland proposes to minimize the amount of cleared land (e.g., averaging only about 20 acres at any given time), this impact should be minimal. The land acreage cleared during a given year will likely be at its highest just prior to the wet season, since the heavy machinery used in such clearing would be more difficult to operate on the saturated terrain. Rainfall from cleared land that has not been mined will continue to flow to natural streams. As mining advances, a greater proportion of surface water would be retained in the active pits, with less flowing overland into existing creeks.

The most significant impact on surface water flows will result from the retention of water in the mine pits. Precipitation caught in the pits will become part of the water recirculation system. Thus, runoff from the site during mining will be less than prior to mining, and stream flows (even flood flows) will be less (Table 3-15). It is estimated that by the fifteenth year of mine operation the total average stream flow from the Farmland site will have decreased by about 2 cfs (5 percent). Data are presented for year 15 because that is the year in which the largest total percentage of land is expected to be disturbed. The stream flows in Table 3-15 include the water expected to be discharged from the mine recirculation system into Hickory and Oak Creeks. These discharges are expected to occur only during periods of high rainfall and flows. If such discharges were not made, the maximum reduction in stream flow from the site during mining would be about 5 cfs (i.e., 3 cfs will be returned to the streams as mine water discharge--resulting in a stream flow reduction of about 2 cfs).

Farmland's proposed mine plan calls for the mining of portions of the Oak Creek and Hickory Creek 25-year floodplain. Diversion channels will be constructed prior to such mining so that the flows can be diverted to adjacent systems. Such diversions will be graded with the necessary meanders and vegetated prior to altering the flow patterns. These diversions will be designed for a 25-year rainfall event. Following mining, floodplains will be back-filled and graded to form a new stream channel and revegetated prior to the reintroduction of the stream. During the mining of Hickory Creek, flow will be diverted to

Table 3-15. DRAINAGE AREAS ON FARMLAND INDUSTRIES, INC. SITE AND DISCHARGE FROM PROPERTY BOUNDARY.

	Before Mining		Year 15 During Mining		After Mining	
	Area	Flow (cfs)	Area	Flow (cfs)	Area	Flow (cfs)
Troublesome	1,167	17.5	1,099	17.4	918	17.1
Hickory	2,261	6.9	1,763	6.0	2,598	6.9
Oak	4,055	15.8	3,190	14.9	3,967	15.7
Peace	250	-	250	-	250	-
TOTAL	7,733	40.2	6,302	38.3	7,733	39.7

Source: Farmland Industries, Inc., DRI June 1979.

Troublesome Creek. The flood flow in Troublesome Creek would be about 40 percent greater for a 25-year rainfall event and 44 percent greater for a 100-year flood if these events were to occur while Hickory Creek is diverted to it. The diversions are described in more detail in the following section.

Less dramatic than the effect of drainage basin changes, but still a factor in the overall impact of precipitation on the mine property, will be the effects of decreased infiltration rates. Infiltration will essentially not occur on the land areas (111 acres) covered by buildings, pavement and other impervious materials. Also, it is expected that the infiltration rate in the clay settling areas (1078 acres) and sand-clay mix areas (3915 acres) will be much less than the original rate. The result will be increasingly greater runoff as the reclamation proceeds. This tendency, however, will be more than offset by the presence of onsite retention areas, with the overall net impact being an approximate 0.5 cfs decrease in runoff.

Another factor likely to significantly affect local stream flows will be a reduction in baseflow which could occur when mine pits near a stream are dewatered. Baseflow in a portion of a stream could be locally absent or less than average during the time that an active mine pit abuts the stream. In dry years groundwater may contribute up to 40 percent of the annual runoff from these streams. In wet years at least 25 percent of the flow is from groundwater. Mining is planned within 200 ft of Troublesome Creek in years 10, 15, and 17; within 100 ft of preserved portions of Hickory Creek in years 1, 12, 13, and 17; and within 100 ft of Oak Creek in years 1, 4, 6, and 10. It is estimated that 0.4 gal/min per ft of mine cut will enter the mine pits (assuming saturated conditions). Thus a 300 ft cut directly adjacent to Oak Creek in mining Block 10A would have a maximum flow of about 3 cfs or 3 percent of the creek's average flow. However, this impact would only be temporary.

A discussion of the water quantity impacts on specific surface waters is presented in the following paragraphs.

Troublesome Creek

There is no mining planned for the Troublesome Creek floodplain. The only mining to be done in this drainage basin will be between years 10 and 19. The largest impact to the Troublesome Creek system will likely be the increased flow during years 13 to 17 resulting from the diversion of Upper Hickory Creek. On the average this additional flow will be only about 4 cfs, but flood flows would result in a more significant addition. The added water would increase the level of the 100-year floodplain in Troublesome Creek by 1 foot. Although some of the area adjacent to the 100-year floodplain (as calculated without the diversion) is scheduled to be mined during the time of the diversion, the channel is fairly steep-walled and floodwater, even with the diverted flow, would not inundate the mining area.

Troublesome Creek flows into the Peace River on Farmland property. The increased flow in Troublesome Creek (from the Hickory Creek diversion) will be so small in comparison to the flow in Peace River that the diversion will have no detectable effect on the river. This flow would normally enter the river through Hickory Creek--about 1 mile downstream of Troublesome Creek.

Hickory Creek

The drainage basin of Hickory Creek contains the areas designated for: the central office for the mine, the beneficiation plant, the clear water pond, and parts of clay settling areas I and IIB. The western divide of Upper Hickory Creek basin is also to be realigned to the west of its original location. However, the net change in the area of the Hickory Creek drainage basin will be negligible, and stream flow at the exit of Hickory Creek from the mine property will be about the same after mining as before.

Flows in Hickory Creek will be greatly altered during the mining of its stream channel. In order to permit mining of portions of the Hickory Creek floodplain, two stream diversions are planned for Hickory Creek. Only about half the length of its original floodplain on the Farmland property is to remain undisturbed. The biggest diversion will be that from Upper Hickory Creek to Troublesome Creek across Sections 1 and 2, T35S R24E. The diversion will be made just below a preserved section of the floodplain. The flow will be diverted for about 4 years while the original floodplain is mined and reclaimed with a lake system. This will deprive the floodplain of lower Hickory Creek of its usual supply of water (about 4 cfs at the point of diversion). Dewatering of the Surficial Aquifer when that area is mined (years 12-14) will further deprive the system of its water supply, to the point that Hickory Creek is likely to be dry at the property exit for a large part of the year (i.e., a temporary loss of 6.2 cfs average flow). The other diversion in the Hickory Creek basin will be to a tributary in Section 26, T34S R34E. This tributary will be permanently relocated from a mineable area to one that is to be otherwise undisturbed. The resultant differences in flow are expected to be slight.

Oak Creek

The portions of Oak Creek to be preserved include most of the Oak Creek Islands area and floodplain. However, parts of clay settling areas I and IIB and all of settling area IIA lie within this drainage basin. Settling area IIA lies just upstream of the Oak Creek Islands area. Two diversions are planned in this area so that the 10.6 cfs average flow can be maintained to Oak Creek Islands while settling area II is constructed and the area to its south is mined. Flow to the Islands area is currently ill-defined and variable. The proposed diversions will stabilize flow at the upstream end of the Islands area. The flow of Oak Creek should remain about what it currently is (15.8 cfs at the outflow from the property).

The primary surface water quality impact associated with mining would be the elevation of suspended sediment loads in the streams which flow from the site due to vegetation removal ahead of the mining operation. Farmland plans to limit the amount of cleared land ahead of the mining operation to only that actually necessary (usually about 20 acres at a given time). This should result in only minimal increases in suspended sediment levels in site streams.

A temporary increase in the suspended sediment load of Oak Creek will probably result from the planned dragline crossing of this creek in mine years 4, 6, and 10. However, this impact should be minimal if, as proposed by Farmland, such crossings are timed to coincide with dry, no flow periods and the crossing areas are vegetated prior to the crossing and returned to their original contours afterwards.

Spills of various materials might also affect water quality. The potential effects of spills of gasoline and diesel fuel are primarily controlled by evaporation losses. For spilled gasoline, almost total evaporation might be expected within several hours. Approximately one-half of a No. 2 fuel oil spill might evaporate in a similar amount of time, while lesser amounts would evaporate for a No. 4 fuel oil spill. The precise rate and total amount of evaporation is related to a number of variables including air and water temperature, humidity, wind, and condition of the spilled material. Typically, the bulk of oil components subject to evaporation will be lost in the first 24 hours of the spill.

Dredge Mining. The impacts associated with the disruption of surface flows described above for dragline mining would also occur if the Farmland deposit were dredge mined. However, dredge mining would require that sufficient water levels be maintained in the active mining area to support the dredge unit. When mining adjacent to undisturbed areas (e.g., lower Hickory Creek), the water contained within the active mining area would maintain the water level in the Surficial Aquifer and thus its baseflow contribution to surface water flows in such areas. Adverse water quality impacts could result from the release of turbid water from the dredge pond to surface waters. Large amounts of such water would have to be stored and handled using the dredge mining method.

Bucketwheel Mining. Bucketwheel mining would have impacts on surface water quantity and quality similar to those discussed under dragline mining.

3.5.2.2.2 Matrix Transport

Slurry Matrix Transport (Farmland's Proposed Action). A break in a slurry pipeline near a stream crossing could result in a dramatic increase in flow and suspended solids content, and smaller increases in pH, fluorides, Ra-226, specific conductance, and total dissolved solids levels in the affected stream. However, the potential for such an occurrence should be minimal if, as proposed by Farmland, double walled pipelines equipped with cut-off valves and pressure sensitive alarms are used at stream crossings.

Conveyor Matrix Transport. This alternative offers a potential water quantity and quality improvement because of the reduction in spill potential through the elimination of slurry pipelines. As indicated above, spills of matrix material from slurry pipelines would increase levels of conductivity, Ra-226, suspended solids, and total dissolved solids. Much smaller increases might occur if matrix is lost from a conveyor transport system.

Truck Matrix Transport. This alternative offers potential water quantity and quality advantages similar to those which conveyor matrix transport offers. The potential for spillage of matrix into surface waters would probably be the least of all the matrix transport alternatives considered. The movement of heavy trucks along haul roads could, however, result in increased suspended solids levels in creeks--especially during periods of heavy rainfall when runoff would be high.

3.5.2.2.3 Matrix Processing

Conventional Matrix Processing (Farmland's Proposed Action). Conventional matrix processing involves the separation of the matrix fractions by washing and flotation methods. The waste streams from the plant consist primarily of sand and clay in slurry form. Some of the water used in these slurry lines creates a potential for downstream flooding, the extent of which would depend on the volume being pumped and the duration of the break. Since such a break would have the greatest affect at a stream crossing, Farmland plans to use double-walled pipe culverts at all stream crossings and install pressure sensitive devices that will sound an alarm should a failure in the inner pipe occur.

In the event of a break in any of the waste or water return pipelines, a potential for degradation of surface water quality would exist. The degradation would be greatest if a clay slurry pipeline broke near a stream crossing. Such a break would greatly increase suspended solids levels in the receiving stream. The use of Farmland's preventive measures described above should minimize the potential for such degradation to occur.

Dry Matrix Processing. Dry matrix processing would likely eliminate the potential for the water quantity impacts discussed above. If the dry processing technique involved only dry separation (i.e., waste sand and clay would be rewetted and pumped to the disposal site following separation), the impacts would be the same as described above for conventional matrix processing.

Dry matrix processing would also likely eliminate the potential for water quality impacts associated with handling of the sand and clay wastes generated.

3.5.2.2.4 Waste Sand and Clay Disposal

Sand-Clay Mixing (Farmland's Proposed Action). Farmland proposes to use sand-clay mixing within mined areas as their primary waste disposal technique. Use of this technique over 3915 acres of the site, as planned by Farmland, will result in the creation of a land surface which will maintain surface water flow from the site at about the existing rate (see 3.5.2.2.7 Reclamation).

Farmland also proposes to dispose of waste sand and clay in separate impoundments. The 1078 acres of clay settling ponds which will be created will remove this acreage from the surface water drainage basins for the operational life of the mine. The clay impoundments will receive a clay slurry at about 3 percent solids which eventually settle to about 25-30 percent solids. During the time when an area is receiving clay slurry, the impoundment would contain material at a wide range of densities--from near 30 percent to less than 3 percent solids. Failures in the dikes used to impound these wastes have occurred in past years, but since the implementation of the state construction and inspection standards in 1971, no dam built by the phosphate industry has failed. Strict compliance with the current standards should insure the integrity of all dams proposed by Farmland. However, an estimate of the maximum area which would be affected by a dam break has been made (Farmland 1979a). The worst-case situation would involve a break in Settling Area I, the largest (495 acres) undivided settling area proposed for the operation. In estimating the area affected by a break in the retention dam for this area, the following assumptions were made:

- the area is filled to its maximum operating capacity of 35 ft above natural grade;
- the break occurs in the north side of the dam and clays escape onto level terrain; and
- the clays are in a semi-solid state and form a slope of 1:1000 away from the breach in the dam.

Based on these assumptions, approximately two-thirds (or 11,500 acre-feet) of the impounded clays would escape and cover an area of approximately 6 square miles. The assumption of level topography is, of course, not strictly realistic. Because of the entrenched topography of the onsite drainage courses, most of the clays released from a dam break would probably find their way into Oak or Hickory Creek. Probably only a few hundred acres of land would be affected, and the clay spill would affect primarily the onsite and downstream stream courses.

In comparison to the worst-case situation of a break in one of the clay settling areas, the area affected by a break in the thickener berm or a sand-clay retention dam would be much less. Only about 15 acre-feet of clay suspension will be impounded above natural grade in the thickener; therefore, even if all the above grade impounded clays escaped, the released material would be only 0.13 percent of the material released in the worst-case situation.

Because of the rapid consolidation of wastes projected for sand-clay landfills, most of the wastes confined in these areas should be of a higher density than the separately impounded clays. Based on data presented by Farmland (1979a), this increase in density will result in a decrease in volume on the order of 35 percent--largely because of the greater degree of dewatering which will result from sand-clay mixing. Thus, a break in a sand-clay mix disposal area dike would result in the release of a smaller quantity of material than if a clay impoundment dike failed. Applying the volume reduction factor to the preceeding clay impoundment failure analysis, the amount released would be about 7500 acre-feet. The actual release would probably be less than this estimate because of the smaller impountment acreages which will be involved in the disposal of sand-clay mix.

Conventional Sand and Clay Disposal. The disposal of all sand and clay wastes generated by the mine using conventional (separate) methods would result in the entrainment of a larger amount of water than would sand-clay mixing. This would result in a reduction in the potential need to discharge from the recirculating water system. The large open ponds which are characteristic of conventional clay disposal would also provide greater surface area for evaporative water losses, further reducing the potential need for a discharge, and would offer water storage capacity not provided by the smaller dikes of sand-clay mix areas.

If conventional sand and clay disposal techniques were used by Farmland, water retention on the site (i.e., zero discharge of effluent) might be accomplished more effectively. On the other hand, the creation of larger areas containing impounded clays would increase the probability of an accidental release which would have serious effects on water quality. If Farmland were to dispose of all the waste clays in such settling areas, approximately 57 percent (2500 acres) of the mined-out area would contain impounded clays to a height of 35 ft above natural grade. Since these areas would be compartmentized, a break would not result in the release of such clays from the entire area. Therefore, the impact should be comparable to that described for a break in a dike of Farmland's proposed Area I. However, the probability of such a break will be greater.

3.5.2.2.5 Process Water Sources

Groundwater Withdrawal (Farmland's Proposed Action). The withdrawal of groundwater from deep (1400 ft) wells should not have any significant effects on surface water quantity or quality in the vicinity of the site.

Surface Water Impoundment. Surface waters impounded on the site for use as process water would consist largely of stored flood flows. The dams used for such storage would probably best operate with the normal level at elevation 65 ft, allowing the 5 ft up to the 70 ft as emergency capacity to catch any heavy rainfall periods. This 5 ft capacity would be approximately 5300 acre-feet of water. The water available to be collected in any major reservoir system depends upon available rainfall. Farmland already plans to collect a nominal average of 10.6 cfs of normal rainfall, and 18.6 cfs of the 25-year maximum flood flow. The excess flow available from the site land area could be expected to be as much as 6.6 cfs (normal rainfall) and 12.6 cfs (for a 25-year maximum flood). Allowing for the minimum discharge of 2.6 and 3.7 cfs to Oak and Hickory Creeks, respectively, the potential reservoir gain, depending upon rainfall intensity, would be:

	2 Yr	5 Yr	25 Yr	100 Yr
Hickory Creek (Acre feet)--	61	489	1435	2347
Oak Creek (Acre feet)--	472	1045	2131	3445

These quantities allow for continuous normal stream flow as well as a certain amount trapped by Farmland within its system. Converting the above flows to million gallons per day (mgd) on a 365 day year, the source volume would be:

	2 Yr	5 Yr	25 Yr	100 Yr
Hickory Creek (Acre feet)--	0.05	0.44	1.28	2.10
Oak Creek (Acre feet)--	0.42	0.93	1.90	3.08
	0.47	1.37	3.18	5.18

Such storage would prevent flood flows from reaching the downstream portions of the affected streams.

A benefit of this alternative would be its potential to store excess clarified water from the recirculating water system, reducing the need for a direct discharge to Oak Creek or Hickory Creek. However, because of the relatively high nitrogen and phosphorus content of Hickory and Oak Creeks (which would feed the reservoirs), the long retention time of water in the reservoirs, and the fairly shallow depth of the reservoirs, high algal productivity within the impoundment may result. Potential water quality problems within an impoundment resulting from such high plant productivity may include algal mats and odors.

3.5.2.2.6 Water Management Plan

Discharge to Surface Waters (Farmland's Proposed Action). Farmland proposes to utilize a water management plan which incorporates recirculation and reuse to a large degree. Normally, there will be no discharges from the mine recirculating water system because retention areas will have sufficient surge holding capacity to accommodate normal process flow and rainfall variations. Water will be discharged to Hickory Creek only during periods of heavy rainfall (Farmland 1979a). The additional volume of water input to natural flows at those times should not cause any significant flooding, etc., above that which would normally occur downstream of the discharge point during such periods.

As indicated above, no discharge of effluent is anticipated under normal rainfall conditions. However, under extreme rainfall conditions excess water will be discharged into Hickory Creek from the clear water pool, but only after flowing through the clay settling area. Beneficiation plant effluent, including reagents used in the flotation treatment, will be mixed with waste clays as these are slurried. The reagents used and the ratio of dilution in the wastewater if they were to pass through the beneficiation process without chemically reacting would be as follows:

Reagent	Consumption (gal/day)	Ratio of Dilution
Sodium Hydroxide	5508	9,600:1
Fatty Acid	3917	13,500:1
Fuel Oil	5998	8,800:1
Sulfuric Acid	3794	13,900:1
Amine	6242	8,500:1
Kerosene	612	86,400:1

Most of the reagents should adsorb onto the clay particles and settle in the disposal areas, leaving only trace amounts in the water.

Depending on flow in Hickory and/or Oak Creek, these discharges may have some effect on water quality in these creeks. Table 3-12 (page 3-63) presents a comparison of the water quality characteristics of slime supernatant from 15 beneficiation plants in Florida with surface water characteristics at the Farmland site. If discharges occur as planned (i.e., primarily in response to heavy rainfall events), increases in the concentrations of selected water quality parameters might be expected. A comparison of the data in Table 3-12 indicates that increases in the receiving water concentrations of specific conductance, fluoride and sulfate would occur. During the high flow season, it is not expected that these increases would exceed water quality standards (Table 3-16). If these discharges occurred during the dry season, when no flow conditions are common, the Florida fluoride standard might be exceeded. Based on the Table 3-12 data, no other water quality standards are expected to be exceeded due to the effluent discharge. A more recent categorization of effluent from similar phosphate rock processing plants by Ochsner and Blackwood (1978) (Table 3-17) leads to the same conclusion.

Another constituent of concern is Ra-226. Mills, et al. (1977) reviewed the beneficiation process with respect to radioactivity in water. If the findings of that study are adjusted using the ratio of central Florida matrix radioactivity to that of the Farmland site, the following can be concluded:

- Most of the waste product radioactivity will be present in the clay entrained water. For the Farmland site, this amounts to approximately 3600 gpm of water at a Ra-226 concentration of <2 pCi/l (dissolved) and 50 pCi/l (undissolved), the latter value being highly dependent upon the total suspended solids in the clay wastes.
- Although no chemical processes are used to treat the discharge from clay settling areas, the concentration of Ra-226 will normally be <1 pCi/l due to removal of suspended solids by settling and the incorporation of some dissolved material in the settling floc.

The concentrations of Ra-226 in dissolved and undissolved fractions of effluent from several clay impoundment effluents (EPA 1979b) have been found to be generally about 0.7 pCi/l (dissolved) and 0.6 pCi/l (undissolved). Comparing these data with available data on surface water Ra-226 concentrations in affected streams (Table 3-12) indicates that Ra-226 concentrations will be higher than the receiving waters. However, existing stream RA-226 levels may not be exceeded if plant

Table 3-16. STATE AND FEDERAL WATER QUALITY CRITERIA AND STANDARDS.

Parameter[1]	Florida Class III Water Standard	National Interim Primary Drinking Water Regulations	U.S. EPA Water Quality Criteria
Alkalinity, Total as $CaCO_3$	20	-	20
Aluminum	1.5	-	-
Ammonia (unionized)	0.02	-	0.02
Bacteriological (Fecal coliform)	200/100 ml	1/100 ml	200/100 ml
Color	-	-	75 (Health)
Dissolved oxygen (min.)	5.0	-	5.0
Fluoride	Marine only	1.4	-
Iron	1.0	-	0.3
Nitrate-Nitrogen	-	10	10
Oils and Grease	-	-	0 (Domestic water supply)
pH (Std. units)	6.0-8.5	-	5.0-9.0
Phosphate, Total as P	-	-	-
Turbidity	-	1.0 STU	-

[1] All units in milligrams/liter unless otherwise noted.

Source: Florida Administrative Code (Section 17-3.121); National Interim Primary Drinking Water Regulations (40 CFR 141); US EPA Quality Criteria for Water. 1976.

Table 3-17. EFFLUENT CONCENTRATION OF SELECTED POLLUTANTS FROM PHOSPHATE ROCK PROCESSING OPERATIONS IN FLORIDA

	Maximum Daily Average Concentration		
Constituent	Low	High	Average
Total Suspended Solids, mg/l	0.18	21.65	8.43
Phosphorus, mg/l	0.36	2.54	1.21
Fluoride, mg/l	1.19	2.42	1.79
pH, pH units	6.0	7.5	

Source: Ochsner and Blackwood. 1978.
Source Assessment: Chemical and Fertilizer Mineral Industry.

discharges occur as expected during periods of high creek flows. In addition to Ra-226, Ra-228 levels will increase at discharge points. Recent evidence (Michel and Moore 1980) indicates that the Ra-228/Ra-226 ratio may be above 2, which would mean that the 5.0 pCi/l combined Ra-228 and Ra-226 water quality standard might be exceeded at the discharge point on occasion. The EPA effluent guideline for the phosphate industry is 9 pCi/l of Ra-226.

Connector Wells. Use of connector wells to discharge excess noncontaminated water from the recirculating water system to deep aquifers would reduce the potential for a surface water discharge and the incremental increase in stream flow that such a discharge would produce.

3.5.2.2.7 Reclamation

Farmland's Proposed Reclamation Plan. As described under Farmland's proposed waste sand and clay disposal plan, most (80 percent) of the reclaimed mine site will be filled with a sand-clay mixture. A single clay impoundment covering 583 acres will also remain, and 235 acres of lakes will be formed. Farmland proposes to deposit sand-clay mix and to grade overburden piles such that surface water will flow from these areas to natural stream courses. The post-reclamation drainage pattern planned for the site is shown in Figure 3-9.

The reclaimed surface soils will probably have infiltration rates lower than the original soils; thus surface runoff will probably be greater. However, additional retention and evaporation will occur from the lakes and marshes created as part of the reclamation plan. Taking these losses into account, an annual average decrease in surface water flow on the order of 0.5 cfs is predicted for the entire site (Table 3-15).

The land cover established on the reclaimed site will be substantially different from that now present. Improved pasture/agricultural land will increase from 2416 acres at present to 4097 acres following reclamation. Although the pasture areas will be planted with forage

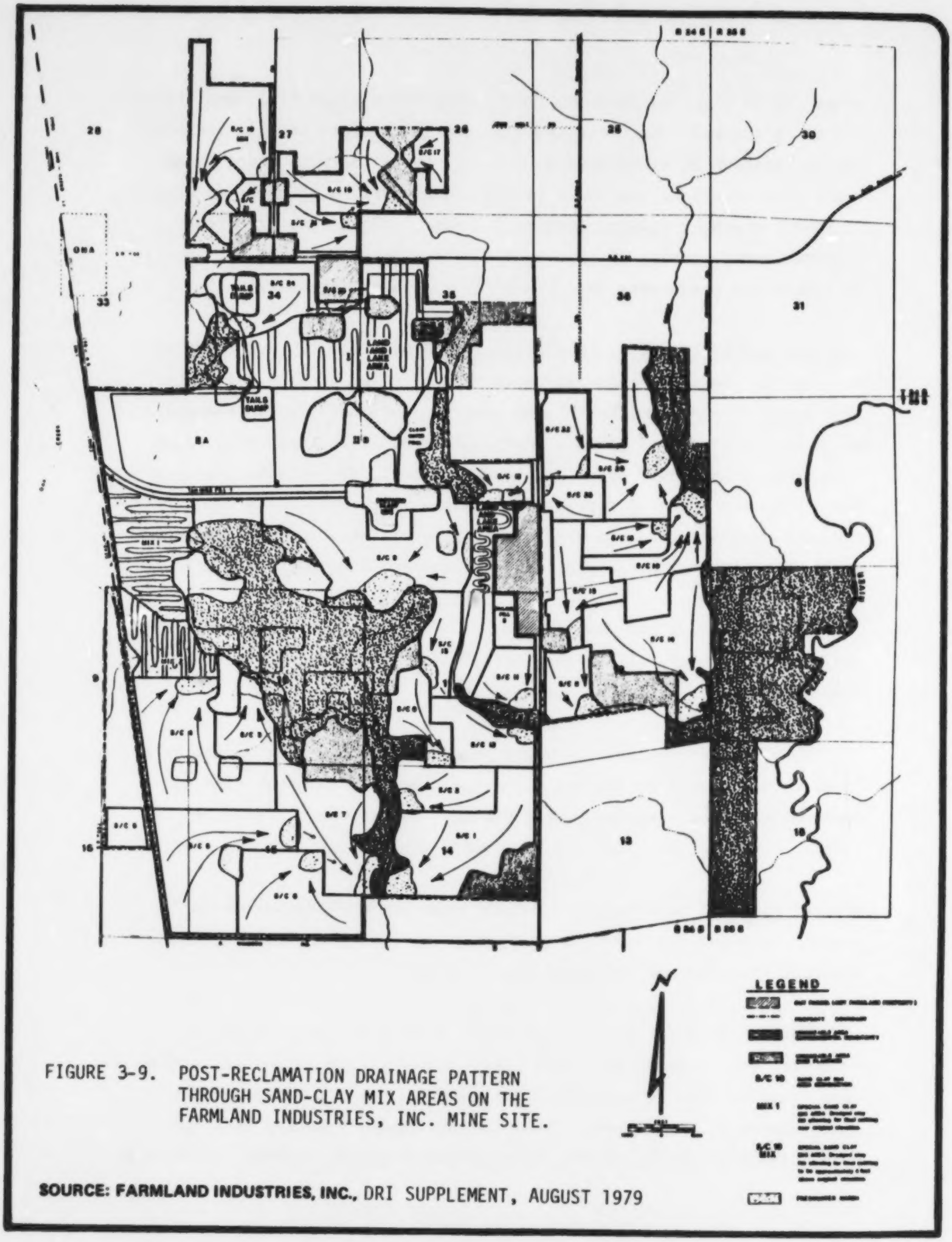


FIGURE 3-9. POST-RECLAMATION DRAINAGE PATTERN THROUGH SAND-CLAY MIX AREAS ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., DRI SUPPLEMENT, AUGUST 1979 crops, it is expected that the runoff from these areas will have higher levels of suspended particulates and other parameters than at present. The application of other materials (e.g., fertilizer) to these lands would also result in increases in the concentrations of these materials in runoff reaching streams leaving the site. If the pasture areas support larger numbers of livestock than are currently present, levels of additional parameters (e.g., coliforms) could also be raised.

Conventional Reclamation. Reclamation as conventionally practiced in the Florida phosphate industry would result in the creation of about 2500 acres of plateau-like terrain (clay impoundments) at an elevation of 35 ft above natural grade. Reestablishment of surface water flows from these areas would not be as easily achieved as would be the case for Farmland's proposed action. During the years that the dikes for such impoundments were standing, rainfall would be entrapped with the dewatering clays--virtually eliminating surface flows from these areas.

More extensive lake areas would also be likely using conventional reclamation methods. These lake areas would further reduce surface flows through retention and evaporation.

Conventional reclamation would produce a land surface which, to a large extent, would be limited to use as pasture. Although some differences may occur, surface water quality impacts would likely be similar to those described for Farmland's proposed reclamation plan.

Natural Mine Cut Reclamation. Natural mine cut reclamation would produce an uneven land surface with drainage from the site hampered by numerous windrows and impounded water areas.

Natural mine cut reclamation would produce a land surface not suitable for use as agricultural land, therefore the potential surface water quality impacts resulting from such use would not occur. The steep slopes of the windrows would tend to erode, creating high suspended sediment levels in the impounded water areas; however, as natural revegetation progressed, these levels would diminish. Over time, surface water quality would probably improve to at least existing levels.

3.6 AQUATIC ECOLOGY

3.6.1 THE AFFECTED ENVIRONMENT

The aquatic ecosystems in the vicinity of the proposed Farmland mine include the Peace River, located along the eastern property boundary, and Troublesome, Hickory, and Oak Creeks, all of which drain portions of the site and eventually empty into the Peace River. All of these systems are greatly affected by the amount of rainfall received. Heaviest rainfall occurs in June-September, with November-December being the driest period.

Oak and Hickory Creeks, which will be directly affected by the proposed action, are intermittent-flowing during the wet season and pooled or dry in the upper reaches during much of the rest of the year. The resulting range of flows produces a stressed environment in terms of water quantity and quality, bottom type, detrital loading, and limited movement of stream organisms.

3.6.1.2 Aquatic Biota

The aquatic biota of the site are composed primarily of species which can colonize upstream areas quickly or can withstand the stresses imposed by intermittent streamflow. The intermittent nature of Oak and Hickory Creeks limits movement of fish and mobile invertebrates to those periods when water is flowing or at least present in the streambed. The various groups which comprise the site's aquatic biota are described below.

3.6.1.2.1 Benthos

Three major groups of benthic invertebrates dominated collections made on the Farmland site. These were the oligochaetes (i.e., aquatic earthworms), dipterans (i.e., flies, midges, and mosquitoes), and molluscs (i.e., snails and mussels).

Oligochaetes were abundant or common in all streams, typically constituting over 25 percent of the benthic organisms collected and at several stations accounting for over 50 percent. Certain oligochaetes are often associated with polluted water, but in this case their abundance appears to reflect a substrate rich in organic matter and water that is occasionally low in dissolved oxygen.

Over 100 dipteran taxa were collected on the site, making this order of aquatic insects the best represented major group. Chironomid (midge) larvae were found at practically all stations. They were able to withstand harsh conditions and were frequently found together with oligochaetes in mucky bottoms. Twenty-eight mollusc taxa were also collected on the site.

3.6.1.2.2 Fish

A total of 33 fish species were collected on or adjacent to the Farmland property from June 1977 to May 1979. Mosquitofish and least killifish comprised over 80 percent of the fish collected and were ubiquitous in the aquatic habitat. These two species are tolerant of the fluctuating and stressful conditions of their habitat and small enough (less than 2 inches) to move about in shallow water. Several commercial and game fish species were also collected (e.g., white catfish, brown bullhead, bluegill, largemouth bass, spotted sunfish, and redear sunfish).

Endangered and Threatened Species. In May 1980, EPA Provided the U.S. Fish and Wildlife Service (U.S. F&WS) Jacksonville, Florida office with a description of the proposed Farmland project and requested a list of endangered and threatened species which might occur in the project's area of influence. U.S. F&WS responded to the EPA's request with a listing of species believed to be present in the area (U.S. F&WS 1980). No fish were among the species listed.

The Florida Game and Freshwater Fish Commission (1979) and Florida Committee on Rare and Endangered Plants and Animals (Gilbert 1978) also list species considered to be endangered, threatened, or rare in Florida. None of the fish species listed by these organizations were found during sampling efforts in streams on the Farmland property or in the Peace River adjacent to the property.

3.6.2 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

3.6.2.1 The No Action Alternative

Under the no action alternative the aquatic environment with its alternating hydroperiod and tolerant organisms is expected to remain essentially as described in Section 3.6.1; however, succession of marshes into bayheads, etc., will modify some aquatic habitats in time. Also, any long-term change in rainfall patterns could affect aquifer levels and result in a shift in the existing plant and animal communities.

3.6.2.2 The Action Alternatives, Including The Proposed Action

3.6.2.2.1 Mining

Dragline Mining (Farmland's Proposed Action). The potential effects of Farmland's proposed mine on the site's aquatic ecosystem are discussed in this section. The effects of three impact-producing actions--destruction of aquatic habitat, alterations of stream flow, and increased turbidity--are described.

Destruction of Aquatic Habitats

Over 1 mile of Hickory Creek streambed will be destroyed due to mining during years 12-14. As a result, all animals that were not able to escape, all aquatic plants, and the physical features constituting the aquatic habitat will be destroyed. Aquatic habitat will be replaced in this area, for reclamation plans call for the restoration of existing flows following mining (see 3.6.2.2.7 Reclamation). Flow is scheduled to be returned to the area 4 years after mining is complete.

Oak Creek will be only minimally affected through the destruction of aquatic habitat since only short sections of the creek will be mined in years 4 and 10, and diversion channels will return water to Oak Creek immediately downstream of the mining activity, thus assuring normal stream flow into Oak Creek Islands. The portion of the creek mined in year 4 is scheduled to be reclaimed by year 10; the area mined in year 10 is scheduled to be reclaimed by year 15. As for Hickory Creek, aquatic habitat will be replaced in the Oak Creek drainage system through reclamation (see 3.6.2.2.7 Reclamation).

Dragline crossings of the preserved section of Oak Creek are scheduled to be made during the dry season at only one location. Therefore, little additional aquatic habitat will be lost, and only minor downstream turbidity should result.

Alteration of Stream Flow

Stream flow reductions resulting from mining (see section 3.6.1) may result in the loss of fish and invertebrates that become concentrated in the remaining pools and wet streambed. In addition, the macrophyte abundance could be reduced, resulting in a loss of habitat for fish and invertebrates. The severity of the effect of flow reductions depends on the season in which they occur. Hickory Creek, which will be most affected by flow reduction, is already an intermittent stream. The plants and animals of such systems are very adaptable to naturally changing water levels (Berra and Gunning 1970; Crossman, et al. 1974; Larimore, et al. 1959). If flow reductions occur during a time of no stream flow, the fish will have moved downstream or into the remaining pools. The insect larvae may have increasingly become part of the drift as the flow slows (Minchall and Winger 1968); oligochaetes and molluscs will attempt to penetrate into the moist bottom but will be lost from the area that is mined. However, if stream flow is drastically reduced at a time of high flow, the fish and invertebrates will not have an opportunity to move out of the area and may become stranded, as was observed by Kroger (1973). Because of the natural resiliency of the local fish, macroinvertebrates and macrophytes, effects of the stream flow reduction on these organisms are judged to be temporary and minimal--lasting from 1 year in Oak Creek to 4 years in Hickory Creek.

Increased Turbidity

A potential for turbid runoff reaching aquatic habitats will exist during land clearing and operation of the mine. The ecological effects of high levels of suspended solids or turbidity on aquatic organisms are described by Cairns, et al. (1972) as: (1) clogging or irritation of gills; (2) blanketing or sedimentation; (3) loss of light penetration; (4) adsorption and/or absorption of various chemicals; and (5) availability as a surface for growth of microorganisms. But turbidity does not persist for long distances downstream, nor does it remain in the water at the discharge (Burns 1972; Barton 1977). Further, fish can either avoid high turbidity levels or can withstand them for short periods (Ritchie 1972). Although some increases in turbidity are expected, impacts on aquatic organisms due to the discharge of turbid water are judged to be temporary, and the probability of the release of any highly turbid water is small. However, some discharge of moderately turbid water is not unexpected.

Dredge Mining. The impacts associated with the destruction of aquatic habitat described above for dragline mining would also be expected with dredge mining. The use of dredge mining would, however, reduce the flow reduction impacts resulting from dewatering. Dredge mining would require that water levels be maintained in the active mining area; thus the surrounding Surficial Aquifer and its contributions to the base flow of adjacent creeks would be maintained. However, there would be an increased possibility for the release of turbid water into surface waters because of the greater amount of such water that would have to be handled and stored.

Bucketwheel Mining. Bucketwheel mining would result in impacts on aquatic ecology similar to those described for dragline mining.

3.6.2.2.2 Matrix Transport

Slurry Matrix Pumping (Farmland's Proposed Action). The proposed slurry matrix transport system presents the potential for pipeline leaks or breaks which could cause increased turbidities and resultant adverse impacts on aquatic biota in downstream segments of Oak or Hickory Creek. However, if double-walled pipes and other safety features are used where the matrix pipelines cross the creeks (as Farmland proposes) the potential will be minimized.

Conveyor Matrix Transport. The use of conveyors for the matrix transport would reduce the potential for matrix-cuased turbidities sedimentation in creeks along the transport routes and thus the potential for adverse impacts on aquatic biota. This assumes, however, that such a conveyor would be covered (at least in the area of a stream crossing) and designed to prevent spillage. Matrix which spilled from the conveyor into a stream would result in impacts comparable to those which would occur if a pipeline leak occurred near a stream. Spillage from a conveyor on upland areas would be less likely to reach a stream than if a matrix pipeline break occurred at the same location.

Truck Matrix Transport. The use of trucks for matrix transport would offer potential advantages similar to those described for conveyor matrix transport. The potential for spillage of matrix into surface waters (and thus aquatic habitats) would probably be the least of all the matrix transport alternatives considered. The movement of heavy trucks along haul roads could, however, result in increased turbidities in creeks--especially during periods of heavy rainfall when runoff would be high.

3.6.2.2.3 Matrix Processing

Conventional Matrix Processing (Farmland's Proposed Action). Conventional matrix processing requires that large volumes of groundwater be used in the separation of the matrix from the waste sand and clay. This water is normally recycled, so that a discharge to surface waters is not required. However, should the recirculating water system become overloaded because of heavy rainfall, a discharge to surface waters would be required--resulting in increases in pollutant levels in Hickory Creek (the primary discharge point). Since such discharges would occur during periods of high rainfall (and high flow), the impact on aquatic biota should be minimal.

Dry Matrix Processing. Dry matrix processing would eliminate the need for the large quantities of water required for conventional matrix processing. This could result in the elimination of the need to discharge to surface waters and thus eliminate impacts on aquatic biota.

3.6.2.2.4 Waste Sand and Clay Disposal

Sand-Clay Mixing (Farmland's Proposed Action). Farmland proposes to dispose of most of the waste sand and clay through the sand-clay mix technique. Separate sand and clay disposal areas will also be required, with waste clays to be impounded in diked areas covering 1078 acres during most of the life of the mine. These large areas will contain clays at various densities, ranging from about 17 percent solids to less than 3 percent solids. Should a dike failure occur in an impoundment dike, this material could flow into natural stream courses and produce tremendous impacts on aquatic biota. A worst-case analysis of the result of a dike failure in one of Farmland's proposed impoundments is presented in Section 3.5.2.2.4.

A study of the effects of such a break revealed that 90 percent of the fish and most of the macroinvertebrates (except for oligochaetes and chironomid larvae) in the affected waters were killed by mechanical suffocation (Ware 1969; Chapman 1973). However, recovery of stream faunal populations was judged to be rapid by both investigators.

Conventional Sand and Clay Disposal. Conventional sand and clay disposal would result in the creation of about 2500 acres of separately impounded clays during the life of the mine (compared to 1078 with

Farmland's proposed technique). This would result in the creation of additional retention dikes and thus increase the probability of a dike failure which would have tremendous impacts on aquatic biota. The large clay settling areas used in conventional clay disposal would consume water via adsorption and evaporation thus reducing the need to discharge excess water to surface waters. Conventional clay disposal might also result in a reclamation plan that would create more acres of lakes on the site, thus increasing the amount of aquatic habitat over that which will result from the proposed action.

3.6.2.2.5 Process Water Sources

Groundwater Withdrawal (Farmland's Proposed Action). The major source of water for the proposed mine will be from onsite deep wells. The production wells will be drilled to an approximate depth of 1400 ft and cased to about 250 ft. Since the drawdown resulting from pumping must meet the requirements of the SWFWMD, the operation of these wells should have little impact on the surrounding aquatic habitats.

Surface Water Impoundment. The creation of surface water impoundments for the storage of runoff from the site for use as process water would provide more than 1000 acres of lacustrine habitat. However, the intermittent creek ecosystems within areas of Oak Creek Island to be preserved under the proposed action would be cleared for reservoir construction. Also, downstream sections of Hickory and Oak Creeks would no longer receive normal flood flows resulting in a shift in species composition from those plants and animals tolerant of flooding and dessication to those needing more stable conditions.

3.6.2.2.6 Water Management Plan

Discharge to Surface Waters. Under Farmland's proposed water management plan, no discharge of effluent is anticipated under normal rainfall conditions until the catchment area increases to over 2500 acres. However, under extreme rainfall conditions a discharge could be required prior to that time. In this event, excess water will be discharged into

Hickory Creek from the clear water pool, but only after flowing through the clay settling area. Beneficiation plant effluent, including reagents used in the flotation treatment, will be mixed with waste clays as these are slurried. The reagents should adsorb onto the clay particles and settle in the disposal areas, leaving only trace amounts in the water. Some of the constituents of the effluent (when discharged) can be approximated from discharges of existing phosphate mines. Mean values (±1 S.D.) are: total suspended solids - 12.4 ± 9.8 mg/l; total phosphorus - 1.3 ± 0.5 mg/l; fluoride - 2.2 ± 0.7 mg/l. Domestic sewage from the mine will be treated to remove 90 percent of the BOD_5 and solids before entering the water system.

The effects of effluent discharge from the sand-clay mix areas on the aquatic biota are judged to be minimal for several reasons. Primary among them is the fact that there normally will be no effluent discharge. When effluent is discharged at times of rainfall in excess of the system's surge capacity, the receiving stream will be flowing rapidly, thus diluting the effluent. Two of the three effluent parameters described are within values measured in local surface waters. The third parameter, fluoride, fits most of the criteria for a potentially important pollutant (Groth 1975), but the concentrations released will be only slightly higher than those in the receiving water.

Connector Wells. The use of connector wells to dispose of Surficial Aquifer water from mine pit dewatering would decrease the net property discharge to surface waters by the amount which the connector wells could drain from the advancing mining area. While this would reduce the volume of water discharged from the property, the concentration of contaminants in any discharge would not likely be lowered.

3.6.2.2.7 Reclamation

Farmland's Proposed Reclamation Plan. Farmland's proposed reclamation plan is designed to restore surface flows (and thus aquatic habitats) to areas as soon as practicable after mining is complete. Hickory Creek will be mined during years 12-14, while Oak Creek will be mined in years 4 and 10.

Farmland indicates that flow will be returned to the current Hickory Creek channel area in year 16, 4 years after mining within the area begins. A lake system will be created through which Hickory Creek will be rerouted, as shown in Figure 2-38 (page 2-83). The upper portion of this 140-acre area will consist of a series of finger lakes forming a meandering channel for the creek. The lower portion of the lake system will consist of an open lake about 600 ft wide and 3000 ft long.

Flow will be returned to Oak Creek following the completion of reclamation in Special Mix Area 2 in year 15. The flow through this area will be through a series of meandors created by the spoils piles. This arrangement will provide maximum area in the restructured floodplain for providing the water retention and nutrient assimilation functions characteristic of such areas.

A land and lake area with extensive littoral zones will be created as a result of mining during the last years of operation (Figure 2-41). Mining depths and the groundwater table in the area are such that the maximum water depth in these lakes should be about 15 ft. Of the 368 acres included in this area, approximately 50 percent of the total surface area will be covered by water and 50 percent by land.

As the aquatic habitats described above are created, recolonization by aquatic biota will begin to occur. Periphyton will likely be the first to recolonize, followed by insect larvae, macrophytes, fish (especially Gambusia affinis and Heterandria formusa) and molluscs (Crossman, et al. 1974). Some studies (e.g., Larimore, et al. 1967; Gunning and Berra 1969; Berra and Gunning 1970) suggest that such recolonization may proceed rapidly, but the actual rate which will occur cannot be stated.

Conventional Reclamation. The aquatic habitats created by conventional reclamation (i.e., reclamation of separate sand and clay disposal areas and mined land) would consist largely of lake areas scattered throughout those areas of the site not covered with impounded clays. Assuming that one half of these areas on the Farmland site were reclaimed as lakes, their combined acreage would be about 1000 acres. This would provide nearly four times the lacustrine habitat that will be created by Farmland's proposed reclamation plan. However, conventional reclamation would not result in the creation of meandering channels and marsh areas that are part of Farmland's proposed plan, for most of the site (about 2500 acres) would be covered with settled clay to an elevation of about 35 ft above existing grade.

Natural Mine Cut Reclamation. With natural mine cut reclamation, mined out areas of the site would be left ungraded. The resultant topography would be very uneven, comprised of overburden windrows and furrows. Water accumulating in these furrows would form many interconnected channels and pools, creating a diverse shallow-water aquatic habitat. The depth of these water areas would be dependent upon the type of waste disposal technique used during the operation of the mine. If sand-clay mix were placed into the furrows (as Farmland proposes to do) the depth would be less than if sand and clay had been disposed of by conventional methods (i.e., separately). In either case, filling of these habitats would occur over time because of sedimentation and plant succession. The result would be a change from open water habitat to marsh and swamp habitat.

3.7 TERRESTRIAL ECOLOGY

3.7.1 THE AFFECTED ENVIRONMENT

3.7.1.1 Vegetation Types

The terrestrial ecosystem of the proposed Farmland mine site is comprised of nine vegetation types* (Figure 3-10). The acreage occupied by each type is as follows:

Type	Acreage	% of Total
Pasture	2416	26
Citrus Groves	1917	25
Early Successional	153	2
Pine Flatwoods-Palmetto Range	937	12
Coniferous Upland Forest	62	1
Hardwood Upland Forest	417	5
Mixed Upland Forest	311	4
Freshwater Swamp	1205	15
Freshwater Marsh	392	5
Total	7810	

Nearly 55 percent (4333 acres) of the site has been drained and/or cleared for development of improved pasture or citrus groves. The citrus groves have been established on the highest and driest portions of the site. Most of the property that has been converted into improved pasture was originally occupied by pine flatwoods. Most of the remaining pine flatwoods and other upland forest types on the site are also heavily grazed by cattle. The least disturbed natural vegetation associations on the site are primarily confined to wetlands and to floodplain areas bordering the major stream courses.

3.7.1.2 Principal Wildlife Habitats

Four principal wildlife habitats are currently found on the site. These habitats have been classified as ruderal, forest, wooded swamp, and freshwater marsh.

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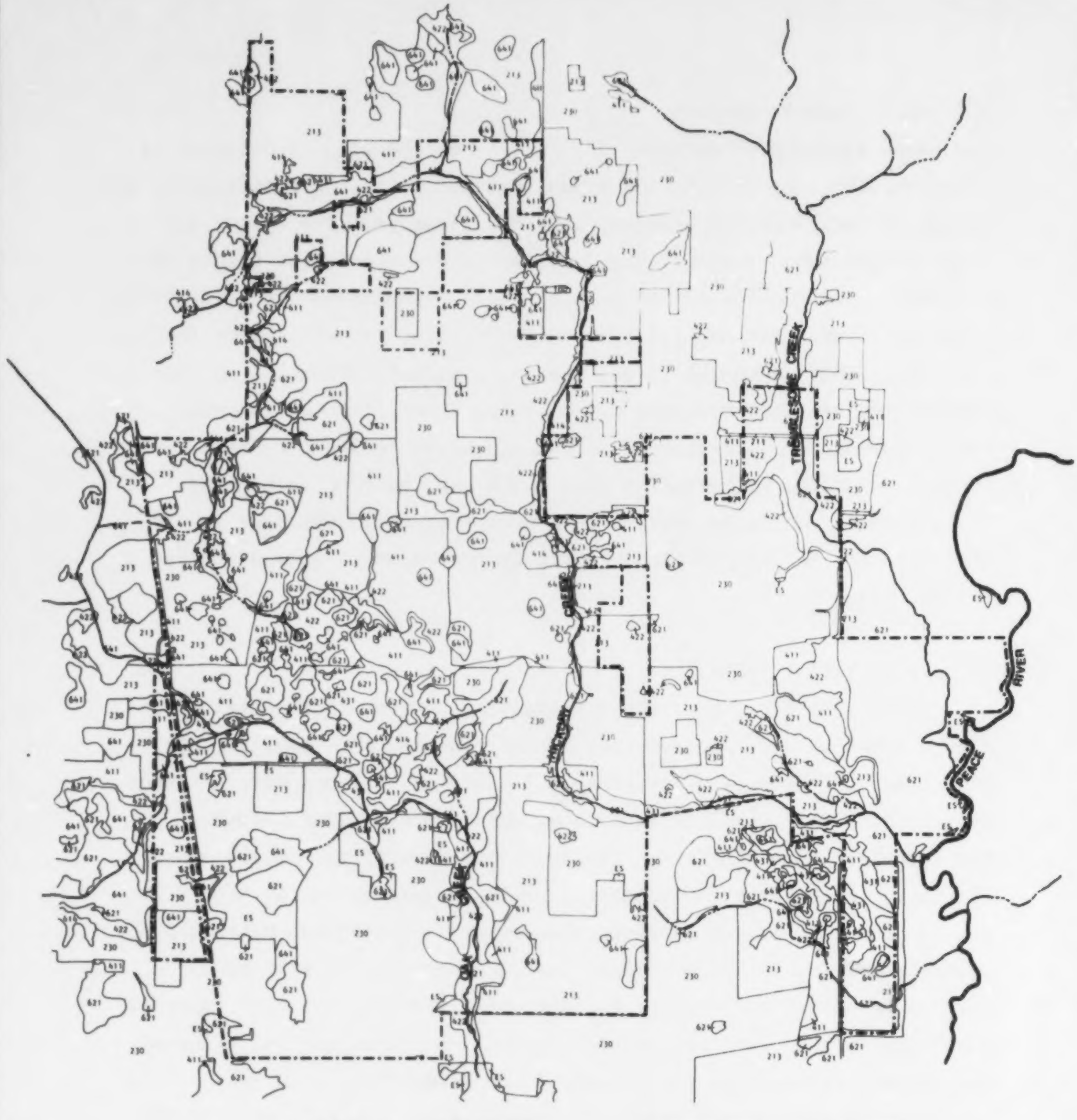
*Using the State of Florida (1976) criteria of the Florida Land Use and Cover Classification System (FLUCCS).



FLUCCS CATEGORY	VEGETATION TYPE	FLUCCS CATEGORY	VEGETATION TYPE
100	URBAN OR BUILT-UP	422	OTHER HARDWOOD UPLAND FOREST
213	PASTURE	431	MIXED UPLAND FOREST
230	CITRUS GROVES	621	FRESHWATER SWAMP
411	PINE FLATWOODS-PALMETTO RANGE	641	FRESHWATER MARSH
414	OTHER CONIFEROUS UPLAND FOREST	ES(262)	EARLY SUCCESSIONAL (OTHER AGRICULTURAL)

N

0 2,000 4,000

SCALE IN FEET

FIGURE 3-10. VEGETATION TYPES ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

3.7.1.2.1 Ruderal Habitat

Approximately 69 percent (5423 acres) of the site is occupied by this habitat type. The FLUCCS types included in this classification are citrus groves, improved pasture, pine flatwoods/palmetto range, and early successional stages. This habitat is created as the result of continual modification of the natural plant communities for agricultural purposes; thus, this habitat has the least value to wildlife of the four principal habitats on the site. Species typically occurring in this habitat included the mourning dove, cattle egret, Florida sandhill crane, common crow, loggerhead shrike, Virginia opossum, raccoon, nine-banded armadillo, white-tailed deer, wild hog, eastern cottontail, and fox squirrel. Wildlife species were most frequently observed in portions of this habitat in close proximity to the other less disturbed habitat types.

3.7.1.2.2 Forest Habitat

Forest habitat covers approximately 10 percent (790 acres) of the site. Hammocks and forested floodplains comprise this habitat. About 82 percent of the area classified as forest habitat support a hardwood forest, with the remaining 18 percent supporting a mixed hardwood/coniferous or pure coniferous forest. This habitat is used to some extent by the majority of wildlife species occurring on the site. The forest habitat provides essential escape cover and travel corridors for species foraging in the more open ruderal habitat, and also provides nesting cover for many of the resident bird species. Species typically occurring in this habitat included the yellow-billed cuckoo, pileated woodpecker, red-bellied woodpecker, downy woodpecker, blue jay, tufted titmouse, Carolina wren, white-eyed vireo, gray squirrel, nine-banded armadillo, and white-tailed deer. The forests on the Peace River floodplain, on Oak Creek Islands, and along Brushy Creek provide the best forest habitat for wildlife on the site.

3.7.1.2.3 Wooded Swamps Habitat

This habitat is comprised of the bayheads and hardwood swamps which are scattered throughout the site region and occupy about 15 percent

(1205 acres) of the site. These scattered swamps and bayheads are often surrounded by extensive pasture or rangeland, thus providing essential cover for wildlife foraging in the pastures and rangeland. Species frequently observed in this habitat included the white-tailed deer, raccoon, wild hog, pileated woodpecker, and blue jay. Trapping of the bayheads and hardwood swamps indicated that these areas supported a higher density of small mammals in comparison to the other habitats on the site. The apparent higher population density of small mammals may be attributable to a lower level of livestock grazing in this habitat as compared to the intensity of grazing in the other habitats in which trapping was undertaken.

3.7.1.2.4 Freshwater Marsh Habitat

Marshes occupy about 5 percent (392 acres) of the site. While drainage, fire prevention, and other agricultural activities have probably had an effect on the ecology of the marshes on the site, these areas still provide nesting and/or roosting cover for a variety of bird species and breeding and/or feeding habitat for a variety of reptiles and amphibians, and are also used by a variety of mammalian species.

3.7.1.3 Game and Commercial Furbearing Species

The site provides habitat for a variety of game and commercial furbearing species. The most abundant species are generally those whose habitat is formed by early successional stage plant communities and forest communities. Field surveys indicate that the commonly occurring game and commercial furbearing species on the site are the eastern cottontail, Virginia opossum, bobcat, raccoon, gray squirrel, wild hog, white-tailed deer, bobwhite, mourning dove, and wood duck. Other less commonly occurring species include the marsh rabbit, Sherman's fox squirrel, red fox, gray fox, striped skunk, river otter, king rail, wild turkey, and mottled duck.

3.7.1.4 Threatened and Endangered Species - Federal

In May 1980, EPA provided the U.S. F&WS Jacksonville, Florida office with a description of the Farmland project and requested a list of endangered and threatened species which might occur in the project's area of influence. U.S. F&WS responded to the EPA request with the following listing of species believed to be present in the area (U.S. F&WS 1980):

Bald eagle - Endangered
Red-cockaded woodpecker - Endangered
American alligator - Threatened
Eastern indigo snake - Threatened
Arctic peregrine falcon - Endangered

The occurrence of several of these species in the area was documented during field studies for the Farmland project. The observations were as follows:

Species	Habitat/Location	Status
American alligator	Peace River and Hickory Creek	Threatened
Eastern indigo snake	Two (2) sightings in mesic woodlands on the site; one (1) road-killed adjacent to citrus grove on the site.	Threatened
Southern bald eagle	One (1) sighting over a freshwater marsh on the site and one (1) sighting near the Peace River.	Endangered

All but the bald eagle are believed to be resident on the Farmland site. Figure 3-11 shows the locations of sightings of endangered and threatened species on the Farmland property. A summary discussion of each of these species' habitat requirements and the status of their populations in the site region is presented in the following paragraphs.

3.7.1.4.1 Bald Eagle

The bald eagle is usually found in riparian habitats, associated with coasts, rivers, and lakes. The species usually nests near large bodies of water, although in interior Florida it will occasionally nest

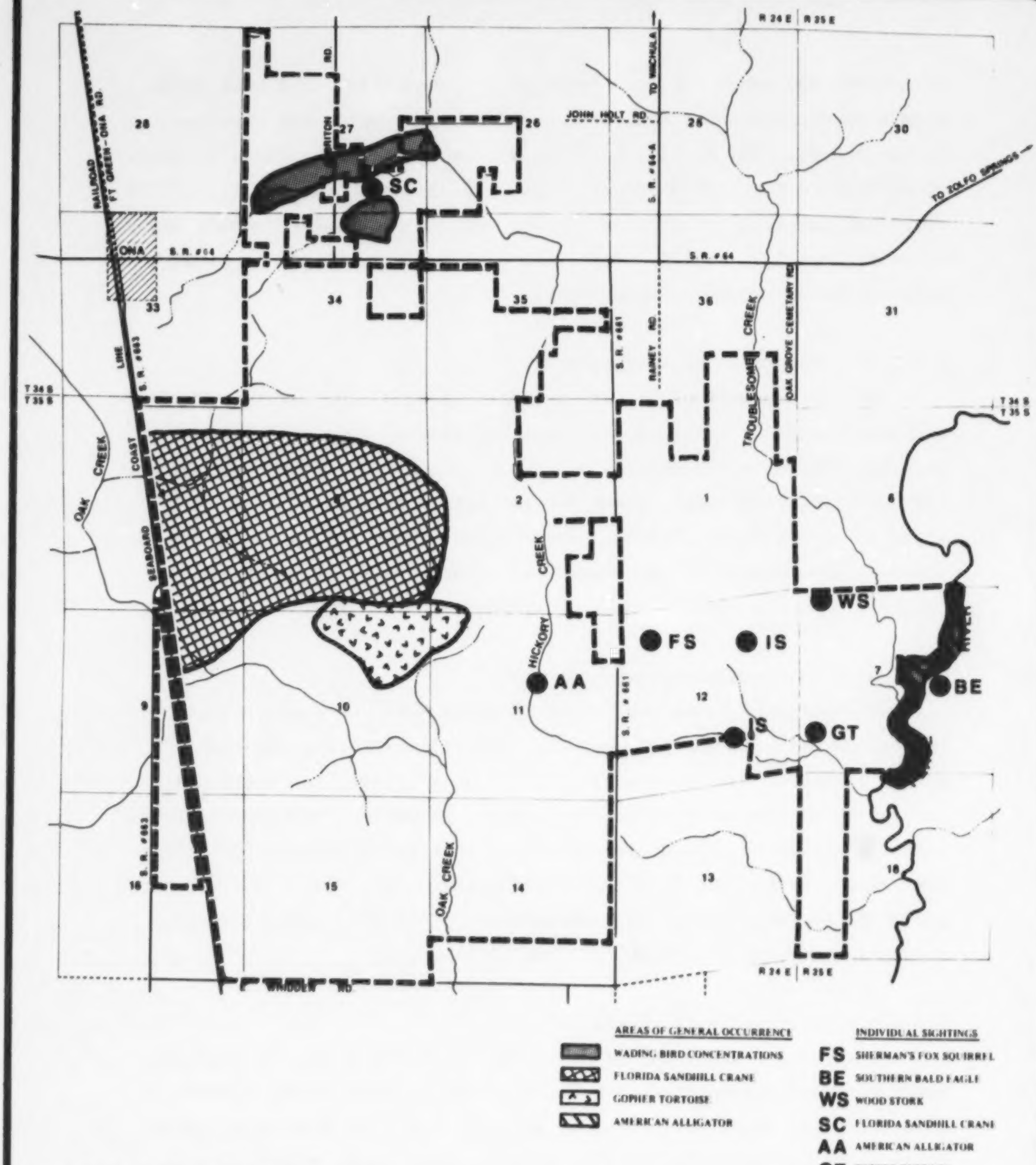


FIGURE 3-11. LOCATIONS OF RARE AND ENDANGERED FAUNA SIGHTINGS ON THE FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979
(MODIFIED BY WOODWARD-CLYDE CONSULTANTS)

on marshes and ponds far from expanses of open water. The bald eagle occurs on the site as a transient and such occurrences are expected to be infrequent. The Florida bald eagle population has declined at least 50 percent in the last 30 years (Palmer 1979), and Layne, et al. (1977) estimated the total population for the western peninsular Florida region to be between 169 and 176. There are no known active bald eagle nest sites in Hardee County (Palmer 1979).

3.7.1.4.2 Red-cockaded Woodpecker

The red-cockaded woodpecker is resident in Hardee County. The red-cockaded woodpecker is generally an inhabitant of open pine woods and usually constructs its nesting cavity in mature pine trees. Due to past harvesting of pine trees, there are few mature pine trees on the proposed site. No red-cockaded woodpeckers were observed during field studies; and because of the absence of mature pines, it is highly unlikely that the species would be resident on the site.

3.7.1.4.3 American Alligator

The alligator is an inhabitant of river systems canals, lakes, swamps, bayous, and coastal marshes. The alligator is a commonly occurring species on the site and Layne, et al. (1977) reported the species to be generally common throughout the western peninsular Florida region. Alligator populations have been increasing substantially from the low levels reached in the late 1950s and early 1960s. The U.S. Fish and Wildlife Service currently estimates the Florida population to be slightly in excess of 400,000 (Palmer 1979).

3.7.1.4.4 Eastern Indigo Snake

The indigo snake occupies a variety of habitats ranging from dry, sandy pine-oak communities to moist tropical hammocks. The species is most suited to mesic environments, and its common occurrence in sandhills and other xeric habitats is possible only where gopher tortoise burrows and other subterranean cavities are available for shelter from the heat (McDiarmid 1978). In the Hardee County region it has been recorded most often from live oak hammocks, old fields, pine flatwoods, and oak-pine sandhills (Layne, et al. 1977). Gopher tortoise burrows and other subterranean cavities are commonly used as dens for egg laying by the indigo snake, and the continuing decline of the gopher tortoise is probably having an adverse effect on indigo snake populations. The indigo snake appears to be a commonly occurring species on the site. Layne, et al. (1977) reported the species to be generally uncommon throughout the western peninsular Florida region. The indigo snake population appears to be in a continuing decline because of habitat loss and illegal collection by snake fanciers or merchants.

3.7.1.4.5 Arctic Peregrine Falcon

The peregrine falcon only occurs in Florida as a wintering species. Florida's coastal areas are the principal wintering areas for the peregrine falcon.

3.7.1.5 Endangered and Threatened Species and Species of Special Concern - State

Additional species observed on the site that have been classified as endangered, threatened, or of special concern by the Florida Game and Freshwater Fish Commission (1979) are listed below:

Species	Classification
Wood stork	Endangered
Florida sandhill crane	Threatened
Gopher tortoise	Special Concern
Florida burrowing owl	Special Concern
Little blue heron	Special Concern
Snowy egret	Special Concern
Louisiana heron	Special Concern

Figure 3-11 shows the locations of sightings of these species on the Farmland property. A summary discussion of each of these species and their habitat requirements is provided in the following paragraphs.

3.7.1.5.1 Wood Stork

The wood stork is a commonly occurring species on the site. There is an active wood stork nesting colony located in Hardee County about 20 to 30 miles east of the site. The wood stork forages in freshwater and brackish wetlands and will travel as much as 60 miles to secure food for its young. Preferred feeding sites are freshwater marshes, flooded pastures, and ditches. The wood stork's survival is dependent upon vast expanses of wetlands capable of producing local concentrations of fish through established patterns of drying and flooding. Wetland drainage and manipulation of water levels are believed to be largely responsible for the decline in the Florida wood stork population.

3.7.1.5.2 Florida Sandhill Crane

The Florida sandhill crane is a commonly occurring species on the site. The species is locally common in areas of suitable habitat in the western peninsular Florida region. The Florida sandhill crane prefers open habitats and is found primarily in wet and dry prairies, improved cattle pastures, and shallow marshes or lakes with sparse emergent vegetation surrounded by grasslands.

3.7.1.5.3 Gopher Tortoise

The gopher tortoise is an uncommon species on the site. The gopher tortoise is an inhabitant of live oak hammocks, sand pine scrub, pine-turkey oak, and various successional types of xeric ruderal habitats. Its principal habitat requirements include dry, well-drained sandy soils and good herbaceous cover on which to feed.

3.7.1.5.4 Florida Burrowing Owl

The Florida burrowing owl is rare on the site. The burrowing owl is a resident of grasslands and dry prairies or any well-drained sandy ground with sparse growth.

3.7.1.5.5 Little Blue Heron, Snowy Egret, and Louisiana Heron

The little blue heron, snowy egret, and Louisiana heron are all species of wading birds that are found in a variety of coastal and freshwater wetlands. Only the little blue heron commonly occurs on the site.

3.7.2 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

3.7.2.1 The No Action Alternative

Under the no action alternative the terrestrial ecology of the Farmland site should continue to remain as described in Section 3.7.1. Most of the site would continue to be used for agricultural purposes. Presently, almost 56 percent (4333 acres) of the site has been drained and/or cleared for citrus groves, truck crops, or improved pasture. Another 173 acres consists of old fields, ditches, roads, rights-of-way, and artificial ponds. The uncleared portions of the site consist of about 4600 acres of pine flatwoods and other upland forest types and about 3650 acres of marshes and forested wetland and floodplain areas bordering the major stream courses. These uncleared areas are also used for cattle grazing. The U.S. Soil Conservation Service recommends that large ranches in Hardee County maintain two-thirds of their land in native range in order to balance improved pasture acreage. If these recommendations were followed in managing the site property, no additional clearing would be required.

3.7.2.2 The Action Alternatives, Including The Proposed Action

3.7.2.2.1 Mining

Dragline Mining (Farmland's Proposed Action). Terrestrial biological communities will be affected by the following activities associated with dragline mining of phosphate at the Farmland site:

- clearing and grubbing
- excavation, mining, overburden deposition, and dewatering
- development of roads, railspurs, parking facilities, various settling ponds, and powerlines
- human activity associated with construction and operation activities

These activities will have direct physical impacts on the site's various biological communities. These impacts will also result in changes in the habitats present and, consequently, alter the area's wildlife populations.

Acreage Altered

About 68 percent (5280 acres) of the mine property will be disturbed during the life of the mine. The site acreages of each vegetation type which would be affected are as follows:

FLUCCS Type	Acres Disturbed	Acres Undisturbed	Percent Disturbed
Pasture	1960	456	81%
Citrus	1757	160	90%
Early Successional	95	58	62%
Pine Flatwoods-Palmetto Range	583	354	62%
Coniferous Upland Forest	15	47	24%
Hardwood Upland Forest	230	187	55%
Mixed Upland Forest	35	276	11%
Freshwater Swamp	320	885	27%
Freshwater Marsh	285	107	73%
Total	5280	2530	68%

A corridor for dragline crossings will also be established in the unmined segment of Oak Creek downstream of the Oak Creek Islands (Figure 2-15, page 2-23). This will result in the removal of 10 acres of vegetation and will disrupt the habitat continuity of this otherwise undisturbed area.

The significance of the impact on the terrestrial ecosystem resulting from the removal of the various vegetative communities depends to a large extent on the overall portion of each community that will be removed. The freshwater swamp and marsh and upland forest communities provide a diversity of wildlife habitats, and their loss will have a more significant effect on terrestrial ecology of the area than will the loss of the agricultural and range communities. The species diversity and productivity of each community affected, as well as its replaceability, are also important considerations in addressing the significance of the impact. The significance of the impact may also vary depending on whether it is considered from a regional or local perspective.

The regional significance of the anticipated impacts was assessed on the basis of the land use characteristics within Hardee County as described in the report titled "Natural Resource Factors Comprehensive Plan Hardee County, Florida" (Adley Associates, Inc. 1979). All of the communities that will be affected by the construction and operation of the mine are common in the county. The proposed development will result in the eventual removal of 1757 acres (2.5 percent) of the 68,838 acres of citrus groves or nurseries; 583 acres (0.4 percent) of the 145,195 acres of herbaceous (palmetto) range; 2055 acres (2.0 percent) of the 102,653 acres of the pasture/cropland; 280 acres (10.3 percent) of the 2714 acres of upland forestlands*; and 605 acres (0.8 percent) of the 78,200 acres of wetlands in Hardee County. Much of the loss of these plant communities will occur gradually over the life of the mine, so that the overall impact will be mitigated by ongoing reclamation. From a regional perspective, the construction and operation of the facility will only remove a small percentage of the total amount of the affected communities found in Hardee County. This loss would become more significant, however, if the cumulative losses of these communities due to possible future mining and development in the county are considered.

The loss of the natural vegetative communities (e.g., upland forest, wetlands, pine flatwoods/palmetto range) will have a greater impact on terrestrial ecology than will the loss of the agriculturally managed lands (e.g., pasture, cropland, citrus groves). The only long-term loss of communities (assuming that the reclamation plan is successfully completed) will be the loss of about 30 percent of the site's pine flatwoods/palmetto range and wetlands communities (583 acres of pine flatwoods/palmetto range and 207 acres of wetlands). Reclamation plans provide for the reestablishment of 339 acres of freshwater marsh and 59 acres of freshwater swamp. Because of the low relief topography, attendant drainage patterns of wetlands and associated hydric soils of wetlands are difficult to restore; therefore, the floristic composition of the restored wetlands is likely to be less diverse and different from the natural wetlands and, consequently, less valuable.

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*Within Hardee County, upland forests and forested wetlands together total about 78,600 acres.

The pine flatwoods/palmetto range community has been subject to a great deal of disturbance as the result of the harvesting of merchantable timber and grazing by livestock. Consequently, the loss of 583 acres of this community is not significant--especially, when compared to the 145,195 acres of palmetto in Hardee County.

Disruption of Wetlands

Although the loss of 605 acres of wetlands appears small when compared to the 78,200 acres of wetlands in Hardee County, the significance of this loss should be judged on the basis of their overall functional importance. From this perspective, the site wetlands were classified following guidelines established by the EPA (1978; 1979). Wetland areas on the property (see Figure 3-12) were classified as either Category 1, 2, or 3 as follows:

- Category 1 Wetlands are those wetlands on the site which occur within the 25-year floodplain of the Peace River or its tributaries upstream to the point of 5 cfs mean annual flow, or wetlands considered to be significant wildlife habitat.
- Category 2 Wetlands are those wetlands which occur in the 25-year floodplain upstream of the point of 5 cfs and isolated wetlands in excess of 5 acres in size.
- Category 3 Wetlands are isolated wetlands 5 acres or less.

Farmland's proposed mine plan will result in the loss and protection of the following acreages of each of the above wetland categories:

	Acres Lost	Acres Protected	Percent Protected
Category 1	0	710	100
Category 2	514	264	34
Category 3	91	18	16
TOTALS	605	992	62

Wetlands not directly disturbed by construction or mining activities may be indirectly affected by these activities. Effects could

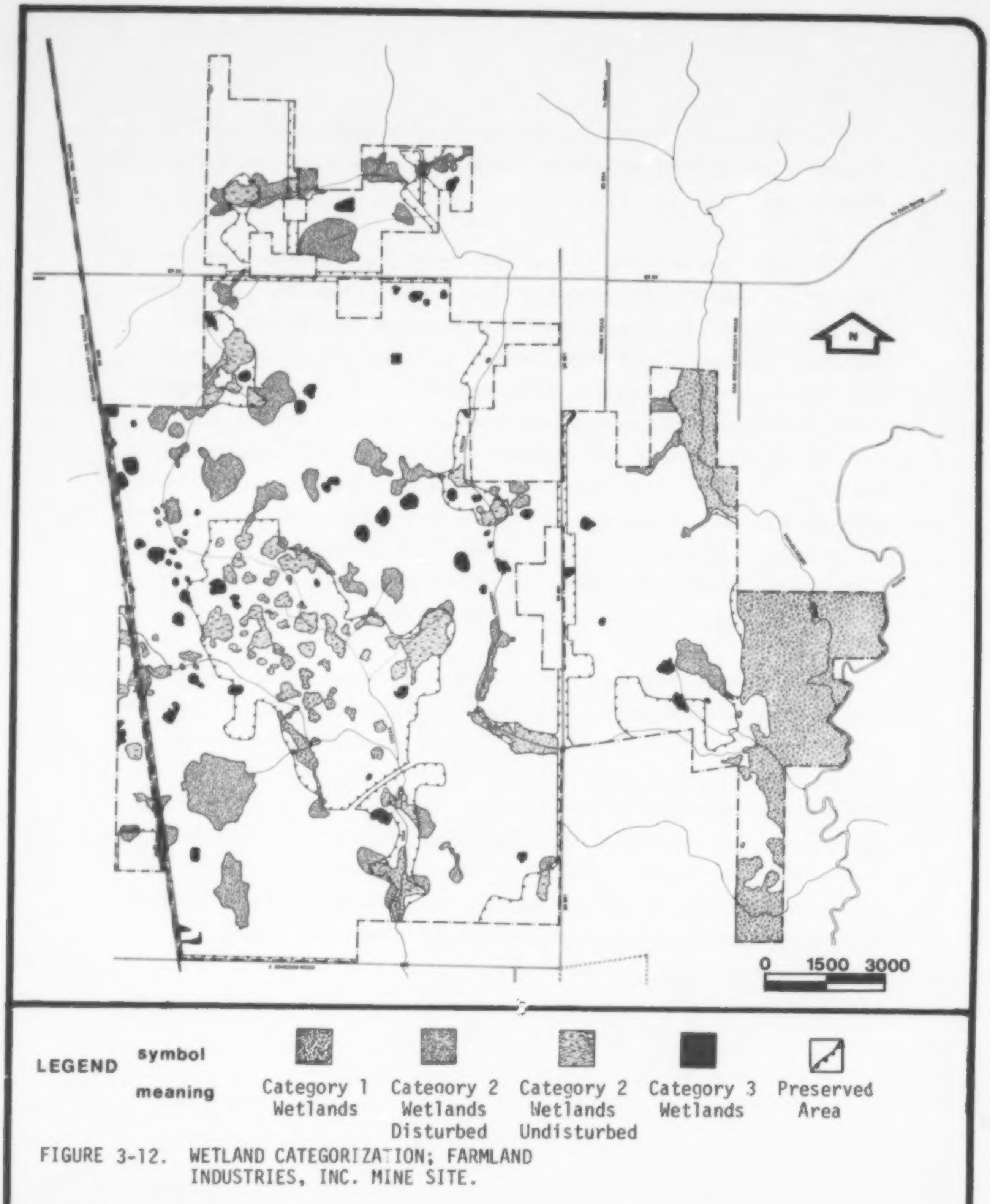

FIGURE 3-12. WETLAND CATEGORIZATION; FARMLAND INDUSTRIES, INC. MINE SITE.

SOURCE: WOODWARD-CLYDE CONSULTANTS (1980) include temporary lowering of water levels, increased sedimentation, changes in groundwater and surface water flow, and long-term hydroperiod alterations.

The water table level in the vicinity of the open mine pits will be temporarily lowered for a period of 1 to 2 years while the ore is mined. Wetlands adjacent to these areas are expected to be affected by the temporary lowering of the water table. The magnitude of this impact will depend upon the rainfall level experienced at that time. Experiments conducted by the Central and Southern Flood Control District (Milleson 1976; Goodrick and Milleson 1974; Davis 1978) have shown that drawdowns of 2 to 4 months can result in substantial changes in plant biomass, species composition, and in the proportion of perennial plants in the marsh during the following season. The long-term effects, however, are likely to be minor and reversible as the vegetation continually adjusts to the prevailing hydroperiod.

Swamps along the lower portion of Hickory Creek may be affected by the temporary diversion of Upper Hickory Creek to Troublesome Creek for mining and the eventual impoundment of water to form a land and lakes system. The diversion will last for 4 years while the Upper Hickory Creek floodplain is mined and reclaimed with a lake system. This will deprive the hardwood overstory on the lower Hickory Creek floodplain of its usual water supply. In addition, the temporary dewatering of the Surficial Aquifer will further deprive the trees of their water supply. During this period the water supply for the trees will depend upon runoff collected in the creek channel.

Impacts on Faunal Populations

To understand the basis of anticipated impact on faunal populations of construction and operation of the mine, it is useful to distinguish between density independent effects and density dependent effects on the environment.

Factors that alter birth and death rates of a species population regardless of population density are called density independent. The operation of the mine, which will ultimately disturb nearly 5300 acres, will cause the death of smaller fauna (as well as the floral species) within the areas to be disturbed. Because these species populations are reduced regardless of their densities, this action is an example of a density independent effect.

A density dependent effect alters the birth rate or death rate as a function of the density of the population. Competition among members of the same population, or competition between one species population and members of other species are examples of density dependent effects. Density dependent factors change in effectiveness as the population size grows. For those species likely to disperse from the site into surrounding undisturbed areas when clearing and grubbing commences (primarily larger fauna such as deer, feral hog, and bobcat), density dependent effects to both the displaced populations and those now occupying similar adjacent habitats (i.e., within the area immediately around the site) can be expected. The particular density dependent factor or combination of factors involved will vary, depending on which species population is affected. In one species, it may be mortality from predators; in another, shortage of food in certain seasons of the year. In some cases, movement of individuals to offsite areas may be largely successful if population levels in the offsite area are below carrying capacity. In general terms, carrying capacity is the limit to population growth of a particular species, imposed by environmental resistance under a given set of conditions (Boughey 1968).

Onsite, the impact of mine operation on local populations of certain species will be significant. Overall, the elimination of less mobile species (density independent effects) and the losses to species populations that move out of the site areas initially (density dependent effects) will represent an incremental loss. However, this loss alone will not be significant to terrestrial faunal populations in the region (i.e., areas within several miles of the site).

Fauna inhabiting the areas to be mined will be displaced or eliminated when these areas are cleared and grubbed. Mobile faunal species (e.g., most bird species, larger mammal species) are likely to move to undisturbed areas when clearing activities begin. More sedentary species (e.g., many reptile and amphibian species, smaller mammal species) will probably be eliminated because of an inability to successfully move from the disturbed areas. Fauna are expected to repopulate disturbed areas following reclamation. The species repopulating the reclaimed areas will depend largely on the type of habitat created.

Faunal species with the most restricted habitat requirements are those species that primarily inhabit wetlands (e.g., alligators, wading birds, marsh rabbit). Many of the species inhabiting the site's upland areas normally occur in all of the principal habitats on the site (e.g., white-tailed deer, feral hog, bobcat, raccoon, crow). In general, the loss of habitats resulting from the operation of the mine is expected to cause a decline in the onsite populations of most resident species. The regional effect of this loss is not expected to be significant because all of the affected habitats are common in the site region and only a small amount of the total available habitat will be lost (e.g., 10.3 percent of forestland and 0.8 percent of wetlands within Hardee County).

Of the 5280 acres that will be disrupted, 4395 acres (83 percent) are ruderal habitat. The loss of this ruderal habitat will not affect most species populations as severely as the loss of less disturbed habitats. The ruderal habitat results from the frequent disturbance and manipulation of vegetation (e.g., range management, pasture, citrus groves, cropland) primarily for agricultural purposes. As a consequence of this management, these areas generally do not support as diverse a fauna as is found in less disturbed habitats. Although the ruderal communities are an important habitat component for some of the site's faunal species such as the sandhill crane, cattle egret, and numerous invertebrates (e.g., herbivorous insects), the majority of the site's species basic habitat requirements are provided by the less disturbed natural plant communities.

Loss of the less disturbed upland forest (280 acres) and wetland (605 acres) habitats will affect a variety of fauna. The bayheads, hardwood swamps, and upland woodlands provide essential cover for many of the faunal species inhabiting the site. Approximately 38 percent of the site's wetlands and 35 percent of its upland forest will eventually be removed. Loss of these habitats should result in greater competition in similar adjacent undisturbed habitats and a resultant loss of individuals because of reduced nesting success, food availability, and/or cover.

Effects on Endangered or Threatened Species

Endangered or threatened species listed by the U.S. F&WS (1980) for the Farmland site area are as follows:

Species	Classification
Bald eagle	Endangered
Red-cockaded woodpecker	Endangered
American alligator	Threatened
Eastern indigo snake	Threatened
Arctic peregrine falcon	Endangered

Additional species listed as endangered or threatened or as species of special concern by the Florida Game and Freshwater Fish Commission (1979) are as follows:

Species	Classification
Wood stork	Endangered
Florida sandhill crane	Threatened
Gopher tortoise	Special Concern
Florida burrowing owl	Special Concern
Little blue heron	Special Concern
Snowy egret	Special Concern
Louisiana heron	Special Concern

The effects of the proposed plan on the above species are discussed in the following paragraphs.

There are no known active bald eagle nests in Hardee County and the species occurs on the site only as a transient. Its occurrence on the site has been infrequent, and its occurrences are expected to continue to be infrequent in the future. Consequently, operation of the proposed mine is not expected to have any noticeable effect on the bald eagle.

The red-cockaded woodpecker has not been observed on the site and, consequently should not be adversely affected by the project.

The American alligator is common on the site. The proposed project will affect about 27 percent (320 acres) of the freshwater swamp habitat on the site and result in the dislocation of some alligators and possibly a decline in the overall alligator population on the site. The alligator is an adaptable species, and disturbed individuals are expected to readily move into adjacent undisturbed swamp habitat. The reclamation plan provides for the creation of 235 acres of lakes. This lake system should compensate for the loss of alligator habitat provided by the freshwater swamps, and no long-term adverse effect on the alligator population in the site area is anticipated.

The eastern indigo snake appears to be a commonly occurring species on the site. The mining of the pine flatwoods/palmetto range and upland forest communities will eliminate some oak hammock and dry flatwood habitats and will thus reduce the onsite habitat available to the indigo snake. About 62 percent (583 acres) of the pine flatwoods/palmetto range and 35 percent (280 acres) of the upland forest communities on the site will be removed over the life of the mine. The habitats created as the result of restoration and reclamation programs are generally not suitable for the indigo snake (Layne, et al. 1977). Consequently, the long-term effect of the proposed project on the indigo snake will be a reduction in available upland habitat which may further reduce the species' population in the site region.

In the site area, the peregrine falcon can be expected to occur primarily as a migrant and, consequently should not be affected by the proposed project.

The mining operations will cause the eventual disturbance of about 73 percent (285 acres) of the freshwater marsh on the site, the habitat of the wood stork. However, since no nesting colonies are located in the immediate site vicinity, the loss of habitat should have little effect on the wood stork population.

The Florida sandhill crane is basically sedentary and is highly territorial during the breeding season, consequently, destruction of shallow marshes and ponds associated with the mining operations may be detrimental to the resident crane population.

Most of the habitat of the gopher tortoise on the site has been converted to citrus groves. Consequently, the mining operations are not expected to have a significant effect on the gopher tortoise population of the region.

The mining operation should have little effect on the burrowing owl population in the area because of the large amount of potential habitat which exists for this species in the site area in the form of improved pasture.

The loss of freshwater marshes as a result of the mining of the site will reduce the habitat of the little blue heron, snowy egret, and Louisiana heron. However, because no nesting colonies are located in the areas affected, there should be no significant effect on the populations of these wading birds in the region.

Dredge Mining. The impacts associated with the destruction of terrestrial habitat described above for dragline mining would also be expected with dredge mining. The use of dredge mining would, however, reduce the indirect effects on wetland habitats that will occur as a result of dewatering of the Surficial Aquifer into open mine pits. Because dredge mining would require that water levels be maintained in the active mining area, the surrounding Surficial Aquifer and water levels in nearby wetlands would be maintained.

Bucketwheel Mining. Bucketwheel mining would result in impacts on terrestrial ecology similar to those described for dragline mining.

3.7.2.2.2 Waste Sand and Clay Disposal

Sand-Clay Mixing (Farmland's Proposed Action). The proposed action calls for the majority of the sand and clay wastes to be disposed of through the sand-clay mix technique. The sand-clay mix is expected to achieve a higher percent solids at a more rapid rate than clays alone (25 percent solids rather than 17 percent solids clay basis) and provide more rapid recycling of a greater amount of water. This will provide for a more rapid achievement of a stable fill. Use of sand-clay mixing will minimize the extent of the land surface to be covered with slow drying, unstable phosphatic clays. Thus, the area to be available for Farmland's varied reclamation plan will be maximized. The use of sand-clay mixing should also result in a land surface that closely approximates the original surface in both contour and elevation. However, it should be noted that large-scale sand-clay mixing has yet to be proven as a workable waste disposal technique in the phosphate industry. The success with which the proposed plan will work depends largely on what other operators achieve in the next 1 to 2 years.

Although Farmland proposes to dispose of most of the waste sand and clay through the sand-clay mix technique, separate sand and clay disposal areas will also be required. Waste clays will be impounded in diked areas covering 1078 acres during most of the life of the mine. These large areas will contain clays at various densities, ranging from about 17 percent solids to less than 3 percent solids. Should a dike failure occur in an impoundment dike, this material could flow overland and into natural stream courses producing tremendous impacts on terrestrial biota. A worst-case analysis of the result of a dike failure in one of Farmland's proposed impoundments (Area I, the largest undivided settling area proposed) indicates that as much as 11,500 acre-feet of material could be released, most of which would find its way into Oak or Hickory Creeks (Farmland 1979a). Because the sand-clay mix should dewater and consolidate more rapidly than separately impounded clays, most of the wastes confined in the sand-clay mix disposal areas should not be in a fluid state. The area affected by a break in a sand-clay retention dike should, therefore, be relatively small.

Conventional Sand and Clay Disposal. This alternative involves disposal of clay slimes as conventionally practiced in the Florida phosphate industry. Clay slimes would be contained within diked areas both on virgin land and over mined-out areas. After the clay slimes had settled and compacted over a period of several years, these areas would generally be left to revegetate naturally or reclaimed as pasture. While conventional clay disposal would result in the creation of large areas of limited agricultural value, it has been shown that these areas could be beneficial to wildlife, particularly wetland species (The Wildlife Society 1978). However, the additional diking required to contain the separately impounded clay wastes would increase the probability of a dike failure over that which exists for sand-clay mix disposal.

3.7.2.2.3 Process Water Sources

Groundwater Withdrawal (Farmland's Proposed Action). The major source of water for the proposed mine will be from onsite deep wells. The production wells will be drilled to an approximate depth of 1400 ft and cased to about 250 ft. Since the drawdown resulting from this pumping must meet the requirements of the SWFWMD, the operation of these wells should have little impact on the surrounding terrestrial environments.

Surface Water Impoundment. Farmland's proposed rainfall collection facilities include only those structures which are a part of the mining, waste disposal, and water clarification and recirculation plans (amounting to a nominal average of 10.6 cfs of normal rainfall). In order to improve the collection of such water for use in the facility processes, additional catchment areas or reservoirs could be provided in the main drainage areas of the mine property. The average flows of Hickory and Oak Creek would be maintained at 6.2 and 15.8 cfs, respectively; therefore the potential reservoir gain would come largely from above normal flows.

The impact associated with the construction of such a reservoir system would be significant because of the loss of the Oak Creek Islands area, which would be preserved under the proposed action. This area lies in the largest natural drainage through the site and thus would be the logical location for the surface water impoundment.

3.7.2.2.4 Reclamation

Farmland's Proposed Reclamation Plan. Farmland's proposed reclamation plan calls for reclamation of the mine site to be undertaken as mining proceeds, so that reclamation of the areas mined initially will be completed during the 9th year of operation, and all reclamation will be completed 30 years after mining begins. The net effect of this plan on the extent of the general vegetation associations which currently exist on the site will be as follows:

Vegetation Association	Current Acreage	Disturbed Acreage	Preserved Acreage	Reclaimed Acreage	Post-Recl. Acreage	Δ Acreage Current: Post-Recl.
Forested Uplands	790	280	510	550	1060	+270(+34%)
Freshwater Swamp	1205	320	885	59	944	-221(-22%)
Freshwater Marsh	392	285	107	339	446	+54(+14%)
Pine Flatwoods/ Palmetto Range	937	583	354	0	354	-583(-62%)
Citrus	1917	1757	160	*	160	-1757(-92%)
Improved Pasture/ Cropland	2569	2055	514	4097	4611	+2042(+79%)
Lakes	0	0	0	235	235	+235
	7810	5280	2530	5280	7810	

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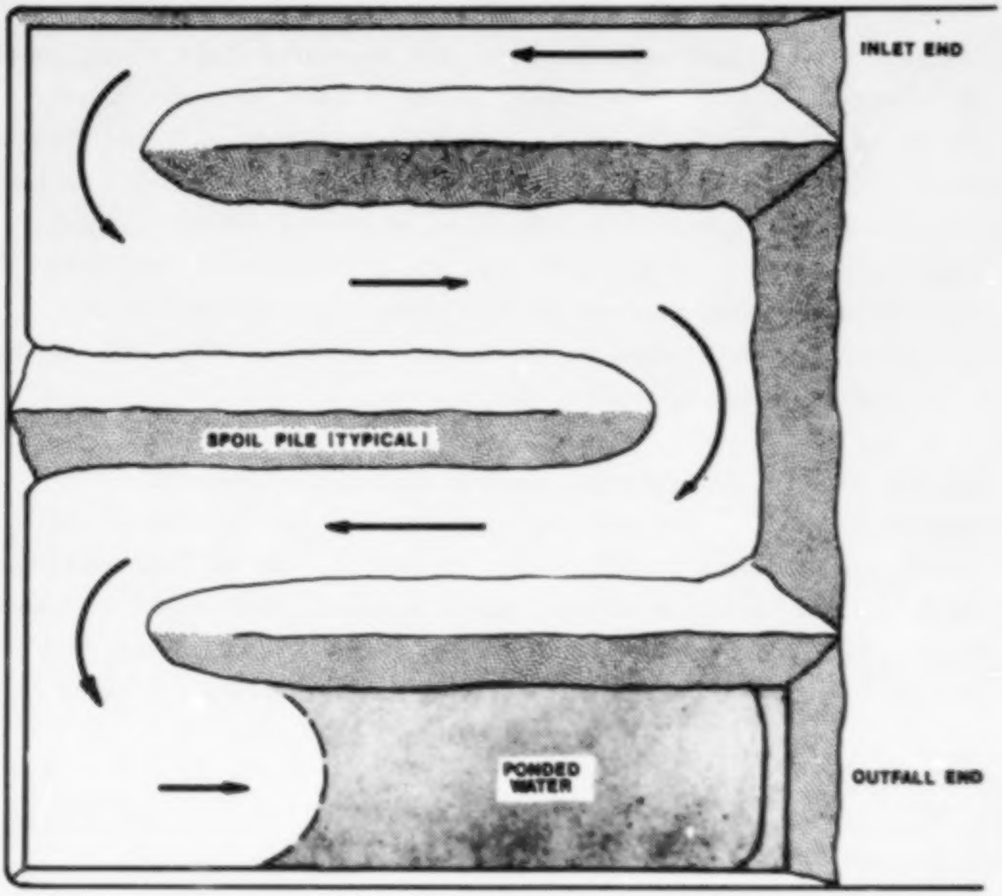
*Only a small citrus planting is planned on reclaimed land.

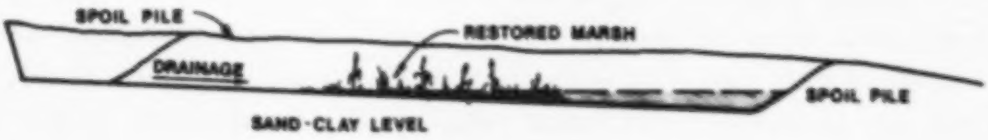
As indicated above, the proposed reclamation plan will greatly increase the acreage on the mine site devoted to pasture and crops. The acreage occupied by forested uplands, freshwater marsh, and lakes will also increase. Most of the reclaimed forested upland acreage (344 of 550 acres) will be in the form of strip plantings between pasture and cropland areas (see Figures 2-12, 2-34, 2-35, and 2-36; pages 2-17, 2-75, 2-77, and 2-79, respectively). Only native species will be used in the plantings. Trees will be obtained from onsite areas to be mined and from the Florida Forest Service. A planting density of 200 trees/acre is planned. A total of 143 acres of upland forest and 52 acres of freshwater swamp (forest) plantings will also be made along the floodplains for the rerouting of Oak Creek and one of its tributaries. Additional plantings of upland forest and freshwater swamp (63 and 7 acres, respectively) will be made on land areas associated with land-and-lakes reclamation.

Farmland's reclamation plan also calls for the creation of 339 acres of freshwater marsh. Most of this (181 acres) will occur as a result of the uneven distribution of sand and clay which is likely to occur in sand-clay mix landfills. This should result in the formation of scattered shallow depressions (Figure 3-13) which would tend to pond water (especially in areas downslope of the waste inlet location). Much of the remaining freshwater marsh would be created as part of the reclamation of the Oak Creek floodplain to the west of Oak Creek Islands. Mine cuts will be arranged such that when the sand-clay mix planted in them has subsided and the creek's flow is returned, the flow will traverse the area much the way that it would along a natural meandering floodplain. Water tolerant trees will be planted along the stream channel, and marsh is expected to develop in the channel itself. The remaining wetland acreage to be created would occur as littoral zones around the lake systems which will result from reclamation. Such areas will be designed to average about 3 ft in depth, and will not exceed 6 ft. In all, 398 acres of wetlands will be created by the proposed reclamation plan, most of which will be in the mined Oak Creek floodplain upstream of Oak Creek Islands. This represents 66 percent of the total wetland acreage disturbed by mining activities, and 77 percent of the Category 1 and 2 Wetlands which would be destroyed.

While the proposed reclamation plan should return the mine site to productive use, the habitats present will not be as suitable for some species of wildlife as the undisturbed site is. This is the case for one important species, the indigo snake (Layne, et al. 1977). Consequently, the long-term effect of the proposed project on the indigo snake will be a reduction in available habitat which may further reduce the species' population in the site region. On the other hand, the impacts on the American alligator should be more than mitigated by the creation of the proposed lake system, while the marsh systems created would provide habitat for species such as the wood stork and Florida sandhill crane.



PLAN VIEW



CROSS-SECTION

FIGURE 3-13. CONCEPTUAL VIEW OF MARSH RESTORATION IN A SAND-CLAY MIX DISPOSAL AREA.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

Conventional Reclamation. Under conventional reclamation a large portion (2500 acres) of the Farmland site would be covered to an elevation of 35 ft above existing grade with impounded clays. Once these had settled and a crust had formed on the surface, this area would likely be planted with forage species for use as pasture. The mined portions of the site not covered with clays would be reclaimed as land and lake areas. Overall, the diversity of habitat for terrestrial wildlife species would likely be significantly less than will develop under Farmland's proposed reclamation plan. Most of the site would likely be reclaimed as pasture and lakes, neither of which provide the total habitat requirements for most species.

Natural Mine Cut Reclamation. Natural mine cut reclamation would greatly alter the potential use of the mined site. Because of the uneven terrain which would be left, the majority of the site would not be suited for agricultural use. The site would, however, be more suited for use by wildlife (once vegetation had reestablished itself) than will be the case under Farmland's proposed reclamation plan.

3.8 SOCIOECONOMICS

3.8.1 THE AFFECTED ENVIRONMENT

3.8.1.1 Population, Income, and Employment

Hardee County is predominantly rural, with two-thirds of the population living in unincorporated areas. The estimated population was 17,800 in 1978. Population growth in Hardee County has been low relative to the region or the state, reflecting a minimal amount of immigration to the county.

Prior to the development of phosphate mining in 1978, the economic base of Hardee County consisted of agriculture and a few manufacturing establishments. The agricultural sector is the largest source of earned income in the country, but the services, trade, and government sectors are also major income providers. Recent phosphate mining has provided a significant new source of income in the mining sector; however, much of this income does not add to economic activity in Hardee County.

The county's labor force was an estimated 8842 persons in August 1979. Unemployment averaged 6.8 percent during 1978 and ranged from 4.5 percent in April to 10.6 percent in August during 1979. This variation is due to seasonal employment in agriculture, especially citrus.

Wage rates in Hardee County are low relative to the more urban counties in the region. Wages in phosphate mining and construction are substantially higher than in other job categories.

Employment and population growth in the county will depend almost entirely on the expansion of the phosphate industry. Phosphate employment in Hardee County is likely to increase at a higher rate and maintain a positive growth rate beyond 1985 since the county's phosphate reserves are just beginning to be tapped.

3.8.1.2 Land Use

Land use in Hardee County is predominantly agricultural. Citrus, cattle, and cropland comprise approximatley half of the entire land area in the county. Because of the predominance of agricultural uses, development is rather limited, and less than 1 percent of the county is urbanized. The three incorporated areas are Bowling Green, Wauchula, the county seat, and Zolfo Springs; commercial and industrial land uses are restricted to the three urban areas but primarily to Wauchula. Generally, other areas of Hardee County are occupied primarily by rangelands or wetlands. Phosphate companies currently own or have options on slightly less than one-half of the land in Hardee County.

The proposed Farmland site in Hardee County occupies 14,373 acres. All of the onsite land is currently leased to private agricultural interests. The highest valued use of land in the site area at present is the 2145 acres of citrus production. The remaining 12,288 acres are used primarily as grazing land for cattle, the quality of which varies considerably. Many of the wetland areas onsite, particularly marshes, show evidence of past attempts to drain them. Wetlands associated with the major drainage courses on the site have best retained their natural character despite such alterations and use.

Land use in the surrounding area is similar to that in the site area. The unincorporated Village of Ona is located approximately 1 mile northwest of the mine property, and has an estimated 88 residential structures and several commercial establishments. One small industrial facility, a post plant, is located adjacent to Ona to the southwest.

Two agencies provide regional planning services to Hardee County. The Central Florida Regional Planning Council (CFRPC), headquartered in Bartow, provides technical assistance and advice to local planning agencies in the county and reviews applications for DRIs. The Southwest Florida Water Management District (SWFWMD) has jurisdiction over water-related planning and consumption in the region, including regulatory control over consumptive water use permits. In addition, SWFWMD assists CFRPC in reviewing water-related aspects of complex DRIs.

The Hardee County Planning and Zoning Board is the designated local planning agency for Hardee County. This Board administers the county's zoning ordinance. In addition, the Board has retained a consultant to help it prepare the comprehensive plan elements required by The Local Government Planning Act of 1975. In general, the county's policy toward land use planning and control has been the typical one of minimal interference with the independent land use decisions of private individuals. However, the county has adopted a mining ordinance which requires the company to submit a Master Mining and Reclamation Plan and to provide evidence that the company has met all other requirements stipulated by other agencies having some jurisdiction over mining.

3.8.1.3 Transportation

The existing transportation network in Hardee County consists of U.S. 17, the major north-south corridor, and State Roads (SRs) 62 and 64 which provide east-west access. The proposed site is directly served by SRs 64, 661, and 663 and the Fort Green-Ona Road, a graded unpaved road maintained by the county. In addition, the Seaboard Coastline Railroad has two tracks through the county, one paralleling the Fort Green-Ona Road and the other paralleling U.S. 17.

More recent Average Daily Traffic (ADT) counts by the Hardee County Engineer's office show an ADT of 447 for the north end of the Fort Green-Ona Road (March 1979), an ADT of 384 for SR 663 north of SR 62, and an ADT between 683 and 803 for SR 661.

The only major traffic generator in the general area at present is the recently opened CF Industries, Inc. phosphate mine which is located about 10 miles north of Farmland's proposed site. Other primary traffic generators in the area are the dispersed ranching, vegetable, and citrus operations and seasonal tourists. Peak traffic occurs during the winter period.

The recently completed traffic circulation element of the comprehensive plan identified three major transportation issues facing Hardee County: status and need for improvements to U.S. 17; the need or desirability of paving Fort Green-Ona Road between SRs 64 and 62; limited access to U.S. 17 available to residents east of Wauchula; and the resultant increased traffic on 64A within the city.

3.8.1.4 Community Services and Facilities

Hardee County had an estimated 6064 year-round housing units in 1976, of which 3.4 percent were vacant. The predominate type and tensure of housing in Hardee County is single-family owner-occupied, with the number of mobile homes having increased in recent years and multi-family units still a negligible portion of the county's housing stock. The major concentrations of housing in the county are in and around the incorporated towns and the outlying communities of Fort Green Springs, Limestone, and Ona. The structural condition of much of the older housing in the county is poor.

Hardee County is served by one school district. Elementary students in grades 1-5 attend an elementary school in the incorporated town nearest their home, but all sixth graders and junior and senior high school students in the county are transported to Wauchula for school. The District Superintendent of Schools expects a total enrollment in excess of 4500 before the end of the 1979-80 school year. Although current enrollment is near the capacity of existing facilities, the district has started construction on a new high school which should give the district the capacity to handle in excess of 5600 students.

Fire protection in the county is currently provided by three municipal volunteer fire departments. Service to the rural areas in the county is poor, but studies are underway to investigate ways of improving fire protection. The Wauchula Fire Department equipment is adequate and in good condition. However, both Bowling Green and Zolfo Springs need new or upgraded pumper trucks.

3.8.1.5 Public Finance

Intergovernmental transfers and property taxes are the major revenue sources for the county government. Service charges and intergovernmental transfers are the major revenue sources for the municipalities. Currently, school district operating revenues are evenly split between local property taxes and state sources; however, state sources provide approximately three-fourths of the school district's revenues for capital expenditures and debt service. Although the property tax base has increased significantly in the past few years, property tax revenues have not increased very much because the county has opted to reduce tax rates.

The county's major expenditure categories include general government, public safety, and economic development. The municipalities' major expenditures are for public works. The district's FY 1980 budget includes $5.9 million for general instruction and support. In addition, the district will spend nearly $6 million for construction of a new high school.

3.8.1.6 Cultural Resources

Historically, the flatland areas of the proposed project area presented very few easily obtainable resources, floral or faunal. Because of its wet nature during the growing season, the land was not well-suited to the types of maize horticulture practiced by Florida Indians. Thus, the flatlands on the Farmland property were probably not a hospitable environment to the south Florida Indians and were utilized only very sporadically. In fact, it is only since power machinery for digging drainage ditches and year-round watering holes became available that the land could be improved sufficiently for use as pasture.

The majority of the Indian sites found in the area were small camps, usually adjacent to a water source. Also reported for northern Hardee County are several earthen mounds of artificial construction and unknown use, some of which contain artifactual material (Wood 1976). As one moves westward out of the flatlands toward the coastal strand, the number of sites increases, especially when the ecotone between the coastal and flatland habitat is reached. These occupations extend up the rivers into the flatlands for a way, but decrease significantly away from the rivers. In the same manner, as one moves eastward toward the central Florida highlands, the number of sites increases and extends for a short way into the flatlands along rivers flowing down from the higher central portion of the state.

Hardee County is located between two discrete and well-defined culture regions. The first, the coastal portion of Manatee and Sarasota Counties to the west, was the southern extent of the various cultures which inhabited the peninsular Florida Central Gulf Coast from about 2000 B.C. to the historic period (Archaic, Norwood, Deptford, Weeden Island, Safety Harbor). To the southeast is the Bell Glade culture region, centered in the Lake Okeechobee Basin but extending an unknown distance northward up the Kissimee River drainage and west along the Caloosahatchee (Sears 1974). The latter region was occupied intensively from about 500 B.C. into the historic period. Hardee County, as well as the coastal strand and Lake Okeechobee Basin, contains Archaic sites dating back at least to 5000 B.C. Paleo-Indian materials dated to 8000 B.C. have also been found in all three regions (e.g., Clausen, Brooks and Wesolowsky 1975). The Archaic sites and the few Paleo-Indian sites are generally small camps found around old sinks (some now silted-in). Quite likely, nomadic hunters utilized the sinks to mine flint and obtain water in what was then arid south Florida (Thanz 1975).

Thus, because of the relative sparseness of its habitats after about 2000 B.C., Hardee County served as a "no-man's land" or buffer zone between the Gulf coastal cultures and the cultures of the Lake Okeechobee Basin. Previous to that time, all three regions were occupied only sporadically by small populations of nomadic Paleo-Indian and Archaic hunters. At no time during the prehistoric period was the region ever an important culture area.

In March and April of 1977 an intensive inventory archaeological survey of the Farmland mine site was carried out by personnel employed by the Florida State Museum (Milanich and Willis 1977). The survey revealed twelve previously unknown scatters of aboriginal artifacts on the property, three of which warranted listing in the Florida Master Site File. Although these three warranted listing, no mitigation was recommended because they had already been extremely disturbed by past agricultural practices. Milanich and Willis (1977) also state that a paleontological site has been reported from the property. It was reported that a partial, badly-deteriorated mammoth skeleton was removed from Hickory Creek by a Wauchula resident in 1965. No paleontological remains were found on the site by Milanich and Willis.

3.8.1.7 Visual Resources

3.8.1.7.1 Physical Environment Description

The existing landform of the proposed Farmland mine site is nearly flat to slightly rolling. Three creeks with some steeply incised banks cut through the property, creating some variation in relief. Dense vegetation, however, tends to obscure the variation in topography. Irregular-shaped bands of tall rounded trees with dense understory grow along the creeks, which are separated by grassy pastures and citrus groves. The pastures are rectangular with hedgerows along some fence lines and occasional clumps of coniferous or hardwood forest within. The citrus groves are uniform and rectangular. Patches of palmetto, swamp or marsh vegetation occur sporadically throughout the site. The natural areas, pastures, and groves create a mixed pattern of open and enclosed spaces. The dominant colors are various shades of green and gray and some tan from dried vegetation.

The site is located in a rural area, and nearly all structures on the site or nearby are either farm housing or associated with agriculture. The site boundary is within 3000 ft of the small community of Ona which has approximately 88 dwelling structures. Most are small, one to two story buildings and are made primarily of wood. Also, there is a small wood mill in Ona with a large two story shed.

3.8.1.7.2 Human Perception Analysis

The most frequent public views of the proposed Farmland mine site would be from cars on SRs 661, 663, 64, and East Whidden Road (Figure 3-14). Views into the site from along these roads are sometimes obstructed by dense vegetation, orchards, or parcels not owned by Farmland. Open areas (unobstructed views) range in distance between 0.5 and 1.5 miles. The flat terrain and vegetation prevents long, sweeping vistas.

As indicated in Figure 3-14, the number of viewers to pass the mine site by car varies between 201 on SR 663, and 2307 on SR 64 (based on ADTs and one person per car). This compares to 10,391 persons calculated for U.S. Route 17 (the nearest U.S. Highway), which is 7 miles away. The heaviest traffic is along SR 64 followed by SR 661. This number may increase should plans for improvement of these roads be implemented. The typical viewer would see the site only briefly in passing; there are no major places to stop and view the site for longer periods of time. Of course, local residents, including those in Ona,

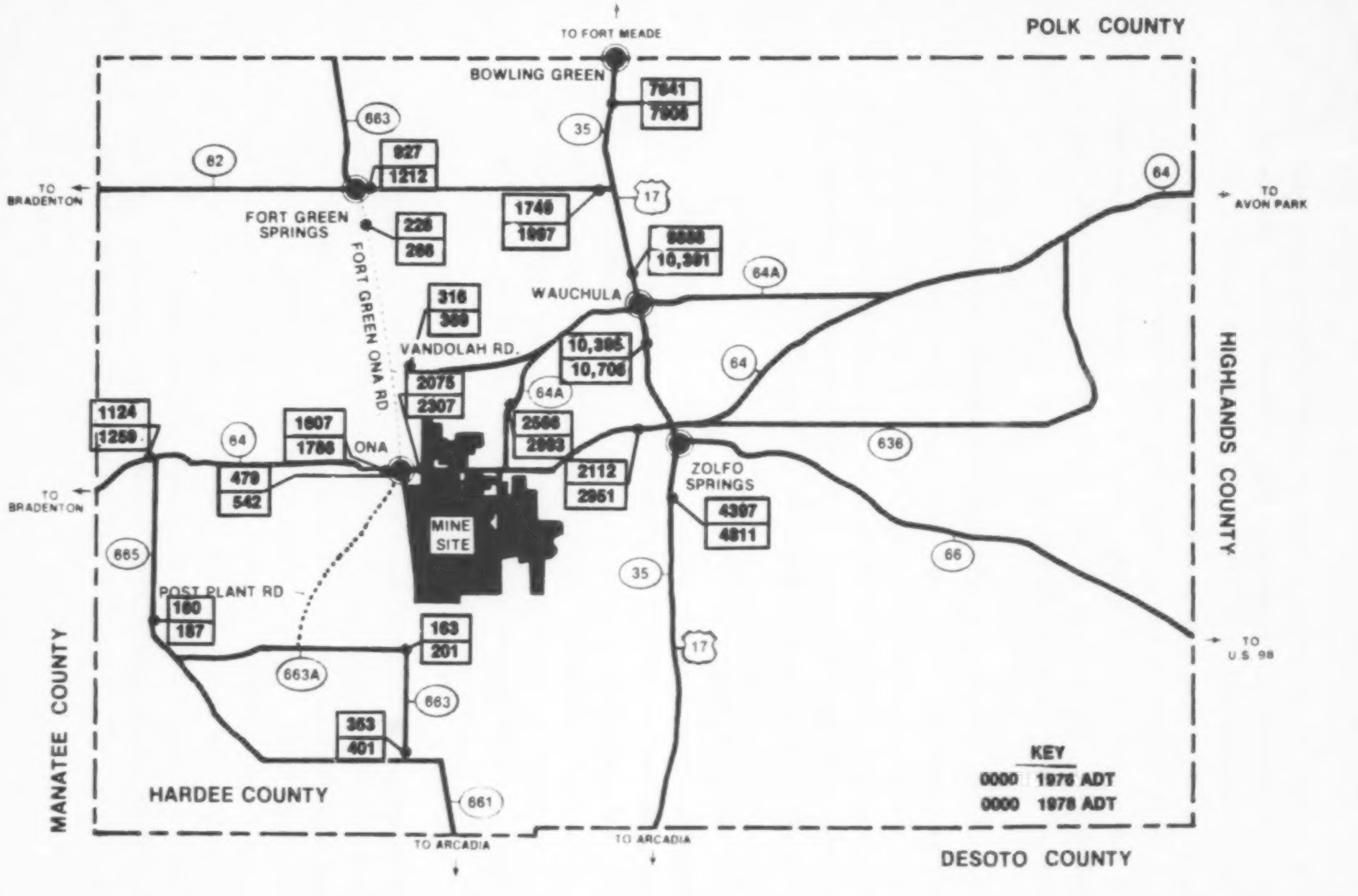


FIGURE 3-14. 1976 AND 1978 ANNUAL AVERAGE DAILY TWO-WAY TRAFFIC (ADT) LEVELS ON ROADS IN THE FARMLAND INDUSTRIES, INC. SITE AREA.

SOURCE: FARMLAND INDUSTRIES, INC., DRI, JUNE 1979

would be able to continuously view the site. The site is not visible to canoers on the Peace River because of dense vegetation.

A survey of regionally pre-empted areas suggests a preference in central Florida for water-based recreation and natural areas (EPA 1978). The nearest recreation areas to the mine site are Pioneer Park (5 miles) and the Peace River canoe trail (on the eastern property boundary). Pioneer Park, which borders the Peace River near Wauchula, has both day and overnight use. The Peace River canoe trail has no public land acquisition associated with the program, and no usage data are available (EPA 1978). The river is a potential nominee for scenic river status, and the site property adjacent to the Peace River has physical qualities similar to other pre-empted areas in central Florida. However, no such state or local recreation purchases are anticipated in Hardee County.

3.8.2 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

3.8.2.1 The No Action Alternative

The no action alternative would have socioeconomic impacts on Hardee County and the central Florida region. The generation of construction and operation jobs and comparatively high phosphate industry income, important to the economy of a rural county like Hardee, would not occur. Similarly, there would be no population influx associated with relocating direct and indirect employment.

Project site land use is likely to remain in citrus production, pasture, and other agricultural uses. All wetlands and environmentally sensitive lands would also remain in their present uses. If the site is not developed for its phosphate reserves, it is probable that the property value would drop (relative to the value for phosphate).

The no action alternative would result in lower traffic levels on local roads and the Seaboard Coastline Railroad than would occur with the project. Subsequently, the demand for transportation facility capital improvements, such as paving the Fort Green-Ona Road, railroad crossings and turning lanes, would be less urgent or unnecessary.

The no action alternative would eliminate an additional demand on an already inadequate housing situation and the increased demands for fire protection, police and medical services which the project will bring. Because current school district expansion is adequate for project created demand, the no action alternative would have no impact on local schools.

3.8.2.2 The Action Alternatives, Including The Proposed Action

The impacts of the action alternatives on socioeconomics have not been evaluated in the same format that has been presented for other disciplines. The socioeconomics evaluation is thus limited to the no action alternative vs. the proposed action. The impacts of Farmland's proposed action are presented in detail below:

3.8.2.2.1 Population, Income, and Employment

Direct employment on the proposed Farmland phosphate mine will peak at 450 employees during construction, with the average being 285 employees. Permanent operating employment is expected to stabilize at 327 employees. Less than 10 percent of the construction employees and approximately 25 percent of the operating employees are likely to be current Hardee County residents. Approximately 25 percent of the operating work force, or about 80 employees, is expected to relocate to Hardee County.

Total regional secondary employment generated by operation of the facility is projected to be between 1000 and 2000. However, only approximately 25 percent of this employment will be new employment located in Hardee County. The remainder will be dispersed throughout the region.

New households relocating to Hardee County as a result of employment generated by operation of the facility will add approximately 980 to 1580 persons to the county's population. This increase constitutes 4 to 7 percent of the projected population of the county in 1984.

Construction labor expenditures for the proposed Farmland project will total $14 million, and the annual operations payroll starting in 1984 will be $6.3 million (in 1980 dollars). Total operations expenditures over the 20-year operation life will total approximately $126 million (1980 dollars). Most (85 percent) of the construction labor expenditures and essentially all of the operations expenditures will accrue to the seven county region. Approximately 10 percent of construction payroll and 50 percent of the operations payroll will accrue to Hardee County residents.

Secondary income from indirect and induced employment would total $41 million for construction and $21 million annually for operations. Approximately 25 percent of indirect and induced income will accrue to Hardee County residents.

The average wage levels of Farmland employees will be significantly higher than general construction, agricultural, and service employees. The effect of the combined direct, indirect, and induced income increases will be an increase in the county per capita income. However, the differential in wages created by the project will inflate local wages and could increase the cost of doing business in the construction, agriculture, and service sectors. Some loss of personnel from these, as well as other sectors, to the mining industry might occur; as a result the disparity between lower and higher incomes will widen.

3.8.2.2.2 Land Use and Value

The Farmland project will have an impact on project site and county land use. Agricultural acreage will increase 7.2 percent onsite, largely because of a 79.2 percent increase in improved pasture acreage. Citrus acreage will, in fact, decrease by 91.7 percent. This loss represents roughly 4 percent of the Hardee County citrus acreage.

Forestland and wetland acreage on the project site will also decrease to 50.0 and 87.0 percent of the existing acreage, respectively.

The project has already more than doubled land values that could be expected from present onsite uses ($11.0 million to $31.2 million). After the completion of mining, post-mining land values will be about 70 percent less than pre-mining phosphate value and 14 percent of its non-phosphate value. The greatest non-phosphate value loss will be where citrus acreage is to be mined.

3.8.2.2.3 Transportation

The Farmland project will generate an average 813 one-way trips on local roads during construction and 858 one-way trips during project operation. Traffic volumes during construction will increase by 4.5 percent on SR 64 west of the site, 29.3 percent on SR 64 east of the site and 9.5 percent on SR 663 south of the site. Operational levels on these routes will be 4.6 percent, 17.8 percent, and 7.6 percent, respectively.

Approximately 2 million tons of wet phosphate rock will be transported by rail from the project site each year of operation. This will require an estimated 70 rail car trips per day, increasing rail traffic on the Seaboard Coastline Railroad track paralleling the Fort Green-Ona Road. Train crossings of SRs 62 and 64 should cause no more than several minutes delay at each crossing·each day.

The increased traffic and transportation facilities associated with the project will require over $2 million in capital improvements and cause an estimated $100,000 increase in annual Hardee County road maintenance costs.

3.8.2.2.4 Community Facilities

The Farmland project will create a housing demand for 330 to 580 housing units for relocating direct and indirect employment. At 1980 housing costs and salary levels, 43 to 76 new single-family units, 113 to 199 older single-family units, 107 to 187 mobile homes, and 71 to 123 rental units would be required.

School enrollment will increase by 246 to 396 students due to project related population increases. With the completion of a new high school, the school district will have the capacity to meet demand from the project and non-project enrollment and current growth rates.

The population increase induced by the Farmland project will decrease the per capita level of fire protection by 5 to 8 percent, requiring the hiring of 7 to 12 additional fire fighters to equal current levels. However, because the population increase is most likely to occur where the fire protection is best in terms of response time, the level of fire protection service may not decrease significantly.

Without expansion to meet demands by the project-induced population increase, the per capita level of medical service will also decrease by 5 to 8 percent, requiring the hiring of at least one medical doctor and three to six hospital beds to equal current levels. At the same time, the employment stability of the phosphate industry and the population increase generated by the project might attract additional services to the county.

3.8.2.2.5 Public Finance

The Farmland project will generate revenue for Hardee County through ad valorem taxation and redistribution of sales tax collected in Hardee County. Once operations commence, the annual revenue generated by the project is estimated at $900,000. Approximately 31.2 percent of the ad valorem revenue will go to the general county fund, 66.4 percent to the school district, and 2.4 percent to the SWFWMD and the Peace River Basin. Most of the sales tax revenue will be distributed to Wauchula, Zolfo Springs, and Bowling Green on a per capita basis.

Hardee County expenditures generated by the Farmland project will consist of one-time capital improvement costs and annual operating expenditures. The capital improvement costs are estimated to total $2.43 million; annual county expenditures will increase from $701,000 to $928,000, depending on population scenario. Increased annual expenditures will be required for educational costs, road maintenance, and additional administrative and service personnel.

While the Farmland project will increase Hardee County expenditures, revenue availability will normally exceed expenditure demands. An exception may occur in 1984 should a major capital expenditure be required to pave the Fort Green-Ona Road. However, after operation commences, revenue generated will exceed expenditures. Some minor mismatches between county and municipal revenue/expenditure may occur, but should be minimized by municipal service charges and the sales tax revenue they receive.

The project will also generate about $2.4 million in severance tax revenue annually, of which 50 to 75 percent will go to the General Revenue Fund of the State of Florida. The remainder of the revenue will be credited to the Land Reclamation Trust Fund and the Florida Institute of Phosphate Research.

3.8.2.2.6 Cultural Resources

Pursuant to Section 106 of the National Historic Preservation Act, EPA consulted with the State Historic Preservation Officer (SHPO), and the Florida Division of Archives, History, and Records Management; to obtain an evaluation of the cultural resource impacts of the Farmland project. Based on the results of surveys conducted on the Farmland site and a review of the Florida Master Site File, the SHOP provided EPA his opinion that the proposed Farmland mine is unlikely to affect any archaeological or historic sites listed, or eligible for listing, on the National Register of Historic Places, or otherwise of national, state or local significance (Percy 1980).

3.8.2.2.7 Visual Resources

Construction. Construction impact assessment for visual resources only considers the completed results of initial construction such as finished buildings, access roads, settling areas, grading, and retention dams. Actual construction activities may be unsightly at times, but this disturbance occurs over a shorter time period and is less significant than the total impact of the completed project elements before operation begins. This discussion will be limited to the beneficiation plant complex and settling areas. Mining activities are included in the operations discussion.

Beneficiation plant complex construction would substantially change the landform in order to create the waste disposal recirculation system that includes canals, clean water pond, and retention dams. The retention dam heights would be as much as 41 ft above the natural grade, which is relatively flat, and have slopes between 20 and 40 percent. The height, slope, and configuration of these dams are not characteristic of this rural area. This landform contrast would be a negative visual impact and would be particularly perceptible to motorists on SR 663 and SR 64.

Large rectangular areas of vegetation would be cleared to construct the beneficiation plant and settling areas. The existing random vegetation patterns and lines would be replaced with sharp, rigid lines that would direct views from SR 663 and SR 64 toward the plant structures. The resulting contrast would be a moderate negative visual impact. Some of this harsh contrast would be reduced once the dams were revegetated for stabilization.

Beneficiation plant structures would create strong visual contrasts in this rural setting. The texture, color, height, and form of these industrial structures are unlike nearby rural structures and do not blend into the surrounding area. The contrasts represent a strong negative visual impact. Initially, the plant would be partially obscured from view by existing vegetation but as mining progresses visibility of the plant would increase. Views from East Whidden Road would be the least affected because the preserved areas south of the plant would block views of most of the structures.

Operation. The landforms of the mine site would be totally transformed during mining operation except in most preserved areas. Open pits, water ponds, spoil piles, and retention dams all strongly contrast with the existing conditions. Portions of stream channels would be totally relocated. Retention dams and spoil piles along roadsides would be the most easily detectable landform change. The buffer along the roadways is not adequately vegetated to provide significant screening. Parcels not owned by Farmland would screen some views, especially along SR 661. Most mining, however, would occur adjacent to the roadways. The negative visual impact to the landform would be the greatest during the middle of the mine's life and then decline as restoration results become noticeable.

Mining operations would remove vegetation gradually, but there would be sharply defined (mechanical) lines and abrupt color changes between existing vegetation and the mining area. These contrasts will be strongest near the preserved areas where vegetation is dense, tall, and irregularly shaped. The contrast would be less distinct in the remaining areas that are primarily citrus and pasture. Strong line contrasts would also be created where vegetation is removed in the preserved areas for dragline crossings. As mining progresses and larger areas become void of vegetation, the contrasts would become more noticeable. The reclamation/revegetation process (discussed below) would take several years to reduce the majority of visual contrasts. These contrasts caused by changes in the vegetation patterns would be a strong negative visual impact.

Although it is not an actual fixed structure, the dragline would be large enough to create a noticeable contrasting profile in the relatively flat terrain.

Post-Reclamation and Abandonment. After reclamation the landforms would be different from the existing conditions. The final topography would be defined as a series of plateaus rather than flat land and would be higher in elevation than the surrounding areas. Elevation differences would be most noticeable from the roadways. The form of the topography would appear manipulated when compared to the existing and surrounding terrain. Former settling areas would create a stronger contrast to the surrounding terrain than other site areas because of a greater increase in elevation. Wetland and lake areas would have strong line and form contrasts because they appear manipulated and unnatural when compared to similar natural areas. Revegetation would reduce or obscure some landform contrasts in the wetland and lake areas but it would take several years to do so.

Revegetation efforts for the post-reclamation plan would totally change the quality of the existing random and irregular mixture of open space and natural areas. Strong contrasts in form and line would occur where reforestation strips meet preserved areas. These strips appear utilitarian, repetitious, and rigid when compared to the existing and surrounding vegetation patterns. The proposed vegetation patterns (land uses) would not blend harmoniously with the preserved areas causing preserved areas to appear isolated. Revegetation would not begin until approximately 7 years after mining is initiated and the success of these efforts is uncertain (experimental in some areas). Therefore, the vegetation contrasts would exist throughout the project life and years after mining ceases. The proposed vegetation of the post-reclamation plan when fully matured would still create negative visual impacts.

Removal of all unnecessary buildings from the mine site after project completion, as proposed by Farmland, would restore the agricultural scale of the area and improve the visual quality.

Summary. Construction, operation, and reclamation of the mine site would create a variety of moderate to strong visual impacts. Initially, the mining sequence would isolate the impacts and allow some to be

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4.0
SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY

The mining of phosphate matrix which lies beneath the surface of the Farmland site and its onsite processing to a "wet rock" state is a short-term, progressive use involving a portion of the total 7810-acre site over the expected 20-year life of the mine. The site's productivity currently includes range and pasture, wildlife, and water. The following discussion of short-term use versus long-term productivity is arranged by environmental discipline groups.

4.1 THE PHYSICAL ENVIRONMENT

4.1.1 AIR

4.1.1.1 Short-Term

The mining/processing of phosphate matrix at the Farmland site will degrade existing air quality and increase existing noise levels. Meteorological effects will be limited to minor microclimate changes which occur as areas are cleared.

Air quality would be degraded by continual small emissions over the life of the mine. Sources include the beneficiation plant (e.g., volatile flotation agents), internal combustion engines (e.g., pay-scrapers), and the disturbed land itself (e.g., Radon-gas). Airborne dust particles from increased vehicle traffic, mining, and processing operations may also degrade air quality.

Noise levels will increase significantly in the immediate vicinity of active land clearing, mining, and reclamation operations; and near the beneficiation plant.

4.1.1.2 Long-Term

Disturbance of the existing geologic strata and surface soils should intermix the generally leached, nutrient deficient soils occurring over most of the site with those at depth which contain relatively higher nutrient levels. This action should increase long-term productivity. The placement of phosphate bearing clays (as sand-clay mix fill) at surface levels should also increase long-term productivity of the site, but the form which this productivity may take is uncertain because of the uncertainties associated with long-term use of such areas.

4.1.2 WATER

4.1.2.1 Short-Term

The mining/processing of phosphate matrix at the Farmland site will result in the disturbance of existing surface water flow patterns and quantities. Flood flows and low flows of Oak Creek, Hickory Creek, and Troublesome Creek downstream of the site would be altered by land form changes, stream severance, diversions, and rerouting by artificial structures.

The withdrawal of groundwater for matrix processing will create a cone of depression in the potentiometric surface of the Floridan Aquifer, lowering the artesian pressure in nearby wells for the life of the project. Withdrawals and pit seepage of water from the Surficial Aquifer will reduce its baseflow contribution to adjacent streams.

Discharges of excess water from the recirculating water system will degrade the quality of the receiving waters (primarily Hickory Creek). Water discharged from this system is likely to have higher nutrient levels (e.g., calcium, magnesium) than the receiving waters, and contain increased concentrations of other undesirable constituents (e.g., dissolved solids, silica, fluoride, radium-226).

4.1.2.2 Long-Term

Reclamation plans call for the grading of mined areas to restore the natural drainage patterns on the site. It is questionable if this can, in fact, be achieved without more operational experience with sand-clay mix reclamation. The reclaimed surface may have slower percolation rates than exist at present, resulting in greater runoff and resultant increased streamflows. On the other hand, the man-formed surface contours will likely contain small depressions, etc. (some of which are planned) where water might collect and evaporate, reducing runoff. In any event, the long-term effect will most likely be an alteration in the streamflow quantity and response time within downstream portions of the affected drainage basins.

Reclamation plans also call for the majority of the site to be utilized as improved pasture. As such, the vegetative cover will likely be more sparse than is currently present over most of the area. This, combined with the nature of the reclaimed sand-clay surface soils which will occur over most of the area, will likely result in increased erosional rates and resultant water quality effects. Long-term impacts may also result from the intensive use of such areas by livestock (e.g., increased fecal coliform levels).

4.1.3 ECOLOGY

4.1.3.1 Short-Term

The mining of phosphate matrix at the Farmland site will result in the destruction of terrestrial and aquatic habitats and loss of many associated fauna. It is probable that some indigo snakes (a threatened species) will be among those lost (see Section 7.0 Coordination). More mobile species will immigrate to unaffected areas. Since the mining will be a progressive action, occurring over the life of the project, the indirect impacts (e.g., overpopulation stress) resulting from emigration of displaced individuals should not be evident. Faunal populations in adjacent and unmined areas will tend to stabilize, so that at the completion of mining they should be similar to current levels. The isolation of some unmined areas (e.g., Oak Creek Islands) may result in their decreased use during the life of the project.

4.1.3.2 Long-Term

Reclamation plans call for the majority of the site to be utilized for improved pasture and other agricultural uses. Such areas will not provide all of the habitat requirements for most of the species which now inhabit the site, thus a long-term loss in the "wildlife" productivity of these areas will occur. Reclamation plans also call for the creation of freshwater marsh and lacustrine habitats in areas where pine flatwoods/palmetto range now occurs. Such reclamation will probably increase the "wildlife" productivity of these areas. The lakes created during the reclamation of the final areas mined will greatly increase the amount of aquatic habitat present on the site, increasing aquatic productivity substantially.

4.1.4 SOCIOECONOMICS

4.1.4.1 Short-Term

The mining/processing of phosphate matrix at the Farmland site will result in increased employment and income levels in Hardee County and the seven-county region. Associated with this employment increase will be an increase in the population of Hardee County. This increase will result in increased demands for housing and services. Tax revenues generated by the project will more than pay for the increased services required to meet existing levels. Housing demands may not be able to be met, at least during the initial years of operation.

Mining will destroy minor archaeological sites present on the property. The loss is not considered significant (see Section 7.0 Coordination).

Mining of the Farmland site will also have an impact on aesthetics. The clearing of existing vegetative cover and post-mining condition of the land will reduce the aesthetic values of the site during the short-term. However, the land features associated with its current aesthetic value are not considered unique to the site.

4.1.4.2 Long-Term

The Farmland project will help support long-term economic growth within Hardee County. Farmland is not the only phosphate mining company with Hardee County holdings. If the Farmland project and other similar mines are permitted to operate in the county, population levels, income levels, and tax revenues should increase significantly over present levels. It is also probable that such development will bring additional employment in related industries (e.g., pumping supplies, etc.) and that industries such as the home building industry will expand.

5.0
IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

A discussion of those resources which would be consumed, depleted, permanently removed, or destroyed are irreversibly altered by the mining of phosphate at the Farmland site.

5.1 DEPLETION OF MINERAL RESOURCES

The extent of recoverable U.S. phosphate reserve has been estimated at 2.2 billion metric tons (U.S. General Accounting Office 1979). World reserves of phosphate rock are estimated by the U.S. Bureau of Mines to be about 27 billion metric tons, but may be much larger (e.g., in 1971 the British Sulphur Corp. estimated world reserves of all grades to be 130 billion metric tons). The estimated current world phosphate rock production is about 120 million metric tons. The U.S., USSR, and Morocco are by far the largest producers of rock, accounting for 41, 26, and 15 percent of world production, respectively. Morocco, however, is the leader in identified reserves with 66.7 percent of the world's supply. The U.S. and USSR accounting for only 8.1 and 3.3 percent of the identified reserves, respectively.

The Bone Valley formation of central Florida is the source of most of the U.S. production, accounting for about 75 percent of total production (which approached 50 million metric tons in 1978).

Two projections of U.S. phosphate rock production have been made--one by the U.S. Bureau of Mines and one by Chase Econometric Associates (U.S. General Accounting Office 1979). The Chase forecast indicates that domestic production will increase to 112 million short tons by 2025, but fails to identify the source of these reserves. The U.S. Bureau of Mines, on the other hand, predicts that U.S. production will peak in 1985, and then decline. Because the U.S. Bureau of Mines has not identified any future potential reserves, their forecast predicts that high grade reserves will be virtually exhausted by 2010.

The U.S. General Accounting Office (1979) has recommended:

> "...that the Secretary of the Interior make a thorough review of the Nation's long-range phosphate position, and report to the Congress on its future availability, and if appropriate, to suggest legislative actions needed to ensure supply. Such a review should be submitted to the Congress by December 1981 and include the following:
>
> 1. A comprehensive assessment of the phosphate reserves of the Nation and the world. To the extent that this is based on unverified data, the Secretary should judge the reliability of such data and the need, if any, for Government verification of proprietary (source) records.
> 2. A determination of the extent to which noneconomic trade-offs, such as environmental needs and other land-use needs, are likely to limit future phosphate development.
> 3. A review and evaluation of alternatives to import dependency and assessment of their costs.
> 4. A submission from the Department of Agriculture contributing to the comprehensive phosphate assessment by estimating future needs and possible food production alternatives to being dependent on foreign fertilizer sources."

In March of 1980, then Secretary of the Interior Cecil D. Andrus responded to the above recommendations. In his letter (Andrus 1980) he stated that the Department of Interior's most recent projections were consistent with the statements in the U.S. General Accounting Office Report, stating "that the United States will continue to be a net exporter of phosphate until at least the year 2000". Since there is no projected shortage of domestic phosphate, Andrus requested an extension (to December 1982) for the completion of the report to the Congress.

From the U.S. Bureau of Mines projections, total cumulative U.S. phosphate production over the next 20 years should be on the order of 1.2 billion tons. The mining of phosphate matrix at a rate of 2 million tons of rock per year over the 20-year life of the Farmland mine will amount to 40 million tons, or about 3 percent of total U.S. production. While this represents an irreversible and irretrievable loss of reserves, data are not available to evaluate this loss with respect to future domestic needs and availability.

Additional commitments of resources will occur as a result of the consumption of oil, gas, electrical power, and various reagents.

5.2 LANDFORM CHANGES

The mining/processing of phosphate at the Farmland site would result in an irreversibly altered landform. Natural soil profiles will be destroyed and existing vegetation cleared. In addition, storage of waste clays will result in the creation of diked disposal areas 35 ft high. The removal of matrix in the final years will result in the formation of lakes where upland areas now occur. The land use of the reclaimed site will be mostly for improved pasture, rather than the pine flatwoods/palmetto range which now predominates.

5.3 COMMITMENT OF WATER RESOURCES

At a pumping rate of 8.83 mgd, more than 60 billion gallons of water will be withdrawn from the Floridan Aquifer over the 20-year life of the mine.

The disruption of streams during mining, the discharge of excess water, and the reclamation of the site following mining will have resultant changes in water quality within their downstream segments.

5.4 FISH AND WILDLIFE HABITAT

The existing fish and wildlife habitat of the Farmland site will be lost and replaced by a modified habitat. The onsite habitat most affected would be ruderal habitat (i.e., rangeland, pasture, and citrus groves), 2 percent of which will be lost to mining. However, the habitat potential of this type is considered to be generally low, except for the sizeable rangeland areas within Oak Creek Islands which are to be preserved.

Thirty-five percent of the existing forest habitat on the site will also be lost, most of this being hardwood upland forest. Species typically occurring in this habitat include the yellow-billed cuckoo, pileated woodpecker, red-bellied woodpecker, downy woodpecker, blue jay, tufted titmouse, Carolina wren, white-eyed vireo, gray squirrel, nine-banded armadillo, and white-tailed deer. The best forest habitat on the site occurs within Oak Creek Islands and along the Peace River floodplain, areas which are to be preserved.

Twenty-seven percent of the existing wooded swamp habitat will also be lost. This habitat is comprised of bayheads and hardwood swamps which are often surrounded by areas of pasture or rangeland, thus providing cover for wildlife which forage in these areas. Species frequently observed in this habitat include the white-tailed deer, raccoon, wild hog, pileated woodpecker, and blue jay.

Seventy-three percent of the freshwater marsh habitat on the site will also be lost. Although the onsite marshes are small and do not appear to attract large aggregations of wading birds, they do provide habitat for many wildlife species including the rice rat, cotton rat, marsh rabbit, otter, wild hog, white-tailed deer, and wood duck.

Farmland's reclamation plan is designed to restore much of the habitat lost through mining. If successful, the net changes in the acreage of each of the above habitats would be as follows:

Ruderal, - 298 acres
Forest, + 270 acres
Wooded Swamp, - 261 acres
Freshwater Marsh, + 54 acres
Lakes, + 235 acres

As indicated above, the largest loss will be in ruderal habitats. This loss is largely due to the loss of 1757 acres of existing citrus groves. This will be replaced with improved pasture. The net loss of 261 acres of wooded swamp habitat represents the most significant acreage change. As indicated above, forest habitat will actually increase following reclamation. Farmland's reclamation plan calls for the planting (at a density of about 200 trees/acre) of mixed forest species. These will consist of 2- to 4-inch diameter trees from areas to be mined and seedlings from the Florida Forest Service. Initially, the vegetative characteristics of the mixed forest plantings will be that of a shrub or herbaceous community. Assuming that no efforts are made to control vegetative development on these planted areas, a mature mixed forest community should eventually develop on these areas as a result of natural vegetative succession. While these areas will provide habitat for various species through the successional period, the degree to which such areas will be used by species such as the indigo snake (a threatened species) remains unknown.

5.5 AESTHETICS

If Farmland's reclamation plan is successful, the resultant landscape could be a visually acceptable one. This man-made landscape would be entirely different from that which now occurs. However, future generations are likely to accept the new landscape as the characteristic landscape.

Permitting of the Farmland project will also contribute to the evolution of the existing environment of western Hardee County to a semi-industrialized one. Existing life styles, with their emphasis on agriculture, are likely to be radically altered as such changes occur.

5.6 HISTORICAL AND ARCHAEOLOGICAL VALUES

Although no significant historical or archaeological sites have been found to date on the Farmland site, the disturbance resulting from mining will destroy any historical and archaeological features which might be found under more intensive efforts. Should any significant sites occur, their destruction would be an irreversible loss to future educational and scientific interpretation.

5.7 REFERENCES

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6.0
COMPARISON OF PROPOSED ACTIVITY WITH AREAWIDE EIS RECOMMENDATIONS

The Final Areawide Environmental Impact Statement for the Central Florida Phosphate Industry published by EPA in November 1978 evaluated the impact of various alternative scenarios of phosphate mining in central Florida. The EPA recommendations represent a scenario of phosphate development which was determined to be as compatible as practicable with other desired and intended land uses. This scenario provides a decision-making tool for all new source phosphate mines in central Florida. The following discussion compares the proposed activity to the EPA recommendations for mining and beneficiation.

6.1 MINING AND BENEFICIATION REQUIREMENTS

6.1.1 ELIMINATE THE ROCK-DRYING PROCESSING AT BENEFICIATION PLANTS AND TRANSPORT WET ROCK TO CHEMICAL PLANTS

The proposed Farmland project does not include a rock dryer and calls for all rock to be transported from the site in a wet condition.

6.1.2 MEET STATE OF FLORIDA AND LOCAL EFFLUENT LIMITATIONS FOR ANY DISCHARGES

Pursuant to Section 401 of the Federal Water Pollution Control Act as amended (33 USC 1251, 1341), the State of Florida issues certification to each applicant for a National Pollutant Discharge Elimination System (NPDES) permit.

All recent NPDES permits issued by the state for phosphate mining facilities have been certified subject to the following conditions:

- The applicant must comply with all applicable requirements of Chapter 403, Florida Statutes, and Chapter 17 series, Florida Administrative Code (FAC).
- Issuance of certification does not constitute state certification of any future land alteration activities which require other Federal permits pursuant to Section 404 of P.L. 92-500, as amended, nor does it constitute approval or disapproval of any future land alteration activities conducted in waters of the state which require separate department permit(s) pursuant to Section 17-4.28, FAC.
- In accordance with Section 17-6.01(2)(a)2a.D., FAC, the following effluent limitations apply to all discharges designated as possibly containing contaminated runoff, process generated wastewater, or mine dewatering discharges from the mining and beneficiation of phosphate rock:

Characteristic		Discharge Limitations		Monitoring Requirements
		1-Day Max.	30-Day Avg.	
TSS	mg/1	25	12	1/wk/24-hr. composite
Total P	mg/1	5	3	1/wk/24-hr. composite
pH		6.0-9.0	6.0-9.0	lwk grab

If the above requirements are met, the discharge from this facility will comply with Sections 301, 302, and 303 of the Federal Water Pollution Control Act, as amended.

This certification must indicate that the terms and conditions of the NPDES permit will result in compliance with Sections 301, 302, and 303 of the Federal Water Pollution Control Act as amended. The state may impose as additional requirements applicable state law or regulations related to water quality standards.

6.1.3 ELIMINATE CONVENTIONAL ABOVE GROUND SLIME-DISPOSAL AREAS

The elimination of conventional above ground slime-disposal areas was recommended by the Areawide EIS. In order to meet this recommendation, the Areawide EIS encouraged the use of waste clays, or a mixture of sand tailings and waste clays, in reclamation, while at the same time it recognized the need for an initial above ground storage area and for retaining dikes around sand-clay mix areas.

Farmland's proposal conforms to this recommendation. Farmland has committed in their mine plan to use a sand-clay mix in land reclamation and thereby reduce the need for traditional, separate disposal areas. The 495-acre initial clay settling area (Area I) planned by Farmland will receive all clay wastes generated before the sand-clay mix procedure becomes operational. Clays stored here will eventually be used in a special sand-clay mix disposal area. A second 583-acre area (Area II) will remain active throughout the mine life to receive clay wastes in excess of the sand-clay mix requirements and to serve as a secondary water clarification and storage area. This will be the only conventional clay storage area left on the site. Upon completion of mining, drainage and drying will be induced to provide for subsidence and crust development of this area. Once the clay has subsided to the desired level, the exterior retaining dike will be pushed toward and away from the settling area to establish a lower grade slope and provide some coarser textured material for the interior soils.

6.1.4 MEET SOUTHWEST FLORIDA CONSUMPTIVE USE PERMIT REQUIREMENTS

The Areawide EIS recommended that any new source mine and beneficiation plant meet Southwest Florida Water Management District (SWFWMD) consumptive use permit requirements. Farmland is obligated to the terms and conditions of the SWFWMD Consumptive Use Permit. Should Farmland fail to comply with all of the conditions set forth in the permit, then the permit shall automatically become null and void.

6.1.5 PROVIDE STORAGE THAT ALLOWS RECIRCULATION OF WATER RECOVERED FROM SLIMES

The Areawide EIS recommended that the new source mine provide storage that allows recirculation of water recovered from slimes. The water recirculation system for Farmland's proposed mining and beneficiation facility provides for containment and for approximately 90 percent water recirculation so that a discharge should be required only during periods of heavy rainfall.

6.1.6 USE OF CONNECTOR WELLS

Another Areawide EIS recommendation was for the use of connector wells. Farmland does not propose to use connector wells to recharge the Floridan Aquifer with groundwater from the Surficial Aquifer, nor was the use of connector wells made a condition of Farmland's SWFWMD Consumptive Use Permit. High gross alpha radiation levels were found in Surficial Aquifer water at the site.

6.1.7 ADDRESS PROPOSED REGULATIONS REGARDING RADIATION LEVELS TO BE PUBLISHED BY EPA AND PROJECTED BY MINING AND RECLAMATION PLANS FOR NEW SOURCE MINES BASED ON TEST BORINGS OF MATERIAL TO BE ENCOUNTERED AND DEVELOP A RECLAMATION PLAN THAT CONSIDERS RADIATION OF SPOIL MATERIAL AND REDUCES AS MUCH AS POSSIBLE THE AMOUNT OF RADIONUCLIDE-BEARING MATERIAL LEFT WITHIN 3-4 FEET OF THE SURFACE

Should buildings (such as residences) be located on the reclaimed Farmland site, indoor radon and radon progeny concentrations would be higher in these structures than outdoors. For any homes that are constructed, the predicted indoor radon progeny (WL) could range from 0.011 over reclaimed sand tailings to 0.018 WL over reclaimed clay settling areas. The value for homes over sand-clay mix areas would be 0.013 WL. Slab-on-grade structures in Polk County over undisturbed lands have WLs ranging from 0.001 to 0.010, with a geometric mean of 0.003. Two standards for WL in existing homes have been proposed: (1) a 0.029 WL total exposure including background (Florida Department of

Health and Rehabilitation Services 1978) and (2) a 0.020 WL total exposure including background (EPA 1979a). The reclamation processes and undeveloped lands were not addressed in detail in EPA's 1979 recommendations to the Governor of Florida. However, the following specific guidance was provided by EPA (1979b) for new homes on any reclaimed, debris, and unmined lands which contain phosphate resources:

> "IV. Development sites for new residences should be selected and prepared, and the residences so designed and sited, that the annual average indoor ...." Working Levels " ...do not exceed .... background levels...."

If the final guidance for reclaimed lands is similar to the recommendation quoted above, then the upper limit of predicted WLs in slab-on-grade homes will be approximately 0.009 WL (normal background of 0.004 WL plus the uncertainty of 0.005 WL). Overall, the reclaimed Farmland site will slightly exceed this upper range. However, Farmland's reclamation plan does not include plans for residential development. If residences were planned they could not be slab-on-grade; they would have to be designed so as to prohibit the accumulation of radon progeny to levels above the .009 WL limit.

6.1.8 MEET COUNTY AND STATE RECLAMATION REQUIREMENTS AND INCLUDE AN INVENTORY OF TYPES OF WILDLIFE HABITAT IN THE AREA TO BE MINED AND THE AREA IMMEDIATELY SURROUNDING IT

On December 4, 1980, Hardee County issued Farmland a Development Order for their project. A Master Plan has also been filed pursuant to the Hardee County Mining and Earthmoving Ordinance.

An inventory of the types of wildlife habitat in the area to be mined by Farmland and in the immediate surrounding area was made and is included in the EIS.

6.1.9 THE MINING AND RECLAMATION PLAN WILL TAKE INTO ACCOUNT THE PROTECTION AND RESTORATION OF HABITAT SO SELECTED SPECIES OF WILDLIFE WILL BE ADEQUATELY PROTECTED DURING MINING AND RECLAMATION

Farmland's mining plan calls for areas to be cleared only as the time of mining approaches. On the average, only about 20 acres should be cleared ahead of the mining operation. Clearing should occur at a rate of about 250 acres per year.

Farmland's proposed reclamation plan calls for reclamation of the mine site to be undertaken as mining proceeds, so that reclamation of the areas mined initially will be completed during the 9th year of operation and all reclamation will be completed 30 years after mining begins. Included in the Farmland plan is the restoration of some mined areas as wildlife habitat. The net effect of this plan on the extent of the general vegetation associations which currently exist on the site will be as follows:

Vegetation Association	Current Acreage	Disturbed Acreage	Preserved Acreage	Reclaimed Acreage	Post-Recl. Acreage	Δ Acreage Current: Post-Recl.
Forested Uplands	790	280	510	550	1060	+270(+34%)
Freshwater Swamp	1205	320	885	59	944	-221(-22%)
Freshwater Marsh	392	285	107	339	446	+54(+14%)
Pine Flatwoods/ Palmetto Range	937	583	354	0	354	-583(-62%)
Citrus	1917	1757	160	*	160	-1757(-92%)
Improved Pasture/ Cropland	2569	2055	514	4097	4611	+2042(+79%)
Lakes	0	0	0	235	235	+235
	7810	5280	2530	5280	7810	

---

*Only a small citrus planting is planned on reclaimed land.

As indicated above, the proposed reclamation plan will greatly increase the acreage on the mine site devoted to pasture and crops. The acreage occupied by forested uplands, freshwater marsh, and lakes will also increase. Most of the reclaimed forested upland acreage (344 of 550 acres) will be in the form of strip plantings between pasture and cropland areas. Only native species will be used in the plantings.

Among the species which will be adversely affected by the project, is one (the indigo snake) considered threatened by the U.S. Fish and Wildlife Service. In order to assess the impact which the project will have on this species population, consultation procedures were implemented with the U.S. Fish and Wildlife Service (see Section 7.0 Coordination). The U.S. Fish and Wildlife Service provided EPA with a Biological Opinion regarding the effects of the project on endangered and threatened species, stating that the population should not be adversely affected by the proposed Farmland project.

6.1.10 PROTECT OR RESTORE WETLANDS UNDER THE JURISDICTION OF THE CORPS OF ENGINEERS, SECTION 404, FEDERAL WATER POLLUTION CONTROL ACT, PURSUANT TO 404(b) GUIDELINES (40 CFR 230)

No specific boundaries of wetland areas have been officially identified by the Corps of Engineers. The following three categories of wetlands were, however, established by EPA in the Central Florida Phosphate EIS:

Category 1:	Wetlands to be protected (not mined).
Category 2:	Wetlands which may be mined but must be restored as wetlands capable of performing useful wetland functions.
Category 3:	Wetlands which can be mined without restoration as wetlands.

Wetlands on the Farmland site were categorized following EPA criteria (EPA 1978; 1979). Wetland areas on the property (see Figure 3-9) were classified as either Category 1, 2, or 3 as follows:

- Category 1 Wetlands are those wetlands on the site which occur within the 25-year floodplain of the Peace River or its tributaries upstream to the point of 5 cfs mean annual flow, or wetlands considered to be significant wildlife habitat.
- Category 2 Wetlands are those wetlands which occur in the 25-year floodplain upstream of the point of 5 cfs and isolated wetlands in excess of 5 acres in size.
- Category 3 Wetlands are isolated wetlands 5 acres or less.

The Category 1 wetlands on the site should include, but are not limited to, those wetlands covered by the Corps' Section 404 jurisdiction.

Farmland's proposed mine plan will result in the loss and protection of the following acreages of each of the above wetland categories:

	Acres Lost	Acres Protected	Percent Protected
Category 1	0	710	100
Category 2	514	264	34
Category 3	91	18	16
Totals	605	992	62

Farmland's reclamation plan will restore 398 acres of wetlands on the mined site. This amounts to 77 percent of the Category 2 wetlands on the site.

6.1.11 MAKE EFFORTS TO PRESERVE ARCHAEOLOGICAL OR HISTORICAL SITES THROUGH AVOIDANCE OR MITIGATE BY SALVAGE EXCAVATION PERFORMED BY A PROFESSIONALLY COMPETENT AGENCY ANY SITES DEEMED SIGNIFICANT BY THE FLORIDA DIVISION OF ARCHIVES, HISTORY, AND RECORDS MANAGEMENT. IF MITIGATION IS CHOSEN, THE RESULTING REPORT SHOULD BE SUBMITTED TO THAT STATE AGENCY FOR EXAMINATION AND COMMENT

An archaeological/historical survey of the Farmland site was conducted and the results were submitted to the Florida Division of Archives, History, and Records Management. It was the opinion of this agency that the archaeological and historical resources of the site did not merit any further mitigative or preservation measures.

6.2 REFERENCES

Florida Department of Rehabilitation Services. 1978. Study of Radon Daughter Concentrations in Structures in Polk and Hillsborough Counties.

U.S. Environmental Protection Agency. 1978. Final Environmental Impact Statement for the Central Florida Phosphate Industry. EPA 904/9-78-026a.

U.S. Environmental Protection Agency. 1979a. Draft Environmental Impact Statement, Estech General Chemicals Corporation, Duette Mine. EPA 904/9-79-044.

U.S. Environmental Protection Agency. 1979b. Indoor Radiation Exposure due to Radium-226 in Florida Phosphate Lands. Office of Radiation Programs, Washington, D.C. EPA 520/4-78-013.

7.0
COORDINATION

7.1 DRAFT ENVIRONMENTAL IMPACT STATEMENT COORDINATION LIST

The following Federal, state and local agencies, public officials, organizations, and interest groups have been requested to comment on this impact statement.

Federal Agencies

Bureau of Outdoor Recreation
Bureau of Mines
Coast Guard
Corps of Engineers
Council on Environmental Quality
Department of Agriculture
Department of Commerce
Department of Education
Department of the Interior
Department of Transportation
Department of Health and Human Services
Department of Housing and Urban Development
Department of Energy
Federal Highway Administration
Fish and Wildlife Service
Food and Drug Administration
Forest Service
Geological Survey
National Park Service
Economic Development Administration
Soil Conservation Service
Public Health Service

Members of Congress

Honorable Lawton Chiles
United States Senate

Honorable Sam Gibbons
U.S. House of Representatives

Honorable L.A. Bafalis
U.S. House of Representatives

Honorable Paula Hawkins
United States Senate

Honorable Andy P. Ireland
U.S. House of Representatives

State

Honorable D. Robert Graham
Governor
Coastal Coordinating Council
Department of Natural Resources
Department of Agriculture and Consumer Services
Department of Community Affairs
Geological Survey
Game and Freshwater Fish Commission
Department of Administration
Department of State
Environmental Regulation Committee
Department of Commerce
Department of Health and Rehabilitative Services
Bureau of Intergovernmental Relations
Department of Environmental Regulation
Department of Transportation

Local and Regional

Polk County Commission
Manatee County Commission
DeSoto County Commission
Hardee County Commission
Hardee County Building & Zoning Department
Tampa Bay Regional Planning Council
Central Florida Regional Planning Council
Southwest Florida Water Management District

Interest Groups

The Fertilizer Institute
Florida Phosphate Council
Florida Audubon Society
Florida Sierra Club
Manasota 88
Florida Defenders of the Environment
Izaak Walton League of America
Florida Wildlife Federation

7.2 PUBLIC PARTICIPATION AND SCOPING

On July 13, 1979, EPA published a Notice of Intent to prepare an EIS for the proposed project which at that time included plans for a chemical fertilizer plant. A scoping meeting for the project was held by EPA in Mulberry, Florida on August 1, 1979. As a result of these efforts to foster public participation, comments regarding the Farmland project were received by EPA during the period leading to the publication of the Draft EIS.

Most of the comments made at the project scoping meeting and in the correspondence which followed were concerned with the potential impacts of the proposed chemical plant. However, in December 1980, Hardee

County denied local approval (Development Order and zoning change) for the chemical plant portion of the project. As a result, Farmland revised its proposed project to include only the mining and beneficiation of phosphate rock at the site (Farmland's proposed action described in this EIS). Accordingly, in February 1981 EPA notified all the participants in the scoping process of this reduction in the scope of the EIS.

7.3 CONSULTATION WITH THE U.S. DEPARTMENT OF INTERIOR

EPA has performed all consultation procedures in accordance with the requirements of Section 7 of the Endangered Species Act of 1973, as amended. On May 9, 1980, EPA provided the U.S. Department of Interior, Fish and Wildlife Service (USF&WS) with a description of the proposed Farmland project and requested that a list of endangered and/or threatened species which may occur in the project's area of influence be provided to EPA (EPA 1980a). On May 19, 1980, the USF&WS commented that three (3) endangered species and two (2) threatened species may be present in the area (USF&WS 1980a). These are as follows:

Endangered	Threatened
Bald eagle	American alligator
Red-cockaded woodpecker	Eastern indigo snake
Arctic peregrine falcon	

On July 16, 1980, EPA provided USF&WS with a biological assessment of the impacts of the Farmland project on endangered and/or threatened species required by Section 7(c) of the Endangered Species Act (EPA 1980b). EPA indicated that after their review of the assessment, they determined that the proposed Federal action (i.e., issuance of a NPDES permit for the proposed project), may effect certain species and officially requested that Section 7 consultation procedures be implemented. On August 19, 1980 USF&WS responded to this request by providing a Biological Opinion regarding the effects of Farmland's proposed project on endangered and threatened species (USF&WS 1980b).

USF&WS stated that, in their opinion, the proposed project is not likely to jeopardize the continued existence of any of the species included in their May 19, 1980 listing or adversely modify habitat essential for their existence. USF&WS did, however, make recommendations to reduce the probability of outright destruction of individuals of one species listed--the eastern indigo snake. These are presented as mitigation measures in Section 2.8.6. It was also requested that Farmland contact the Endangered Species Coordinator for the Florida Game and Freshwater Fish Commission regarding the relocation of indigo snakes encountered on the property and that Farmland maintain records and report to USF&WS the number of indigo snakes relocated and where, and the number of mortalities incurred in the relocation program.

7.4 CONSULTATION WITH THE STATE HISTORIC PRESERVATION OFFICER

EPA has carried out all consultation requirements established by Section 106 of the National Historic Preservation Act of 1966. On July 15, 1980, EPA provided the State Historic Preservation Officer (SHPO), Florida Department of State, Division of Archives, History and Records Management, with a description of the proposed Farmland project and a Cultural Resources Assessment of the Farmland site (EPA 1980c) pursuant to the procedures for consultation and comment promulgated by the Advisory Council on Historic Preservation in 36CFR Part 800. On October 14, 1980, the SHPO replied to the EPA request by stating that it is unlikely that the Farmland project will affect any archaeological or historic sites listed or eligible for listing in the National Register of Historic Places, or otherwise of national, state, or local significance (Percy 1980).

7.5 COORDINATION WITH THE U.S. ARMY CORPS OF ENGINEERS

Certain wetlands on the Farmland site fall under the jurisdiction of the Corps of Engineers (Corps), and the execution of the proposed project in those areas will require a Section 404 (Federal Water Pollution Control Act) permit from the Corps. In view of the Corps' responsibility in this area, EPA has coordinated closely with them in the preparation of this EIS. In July 1979, EPA, the Corps, and Farmland executed a joint Memorandum of Understanding which established EPA as the lead agency and the Corps as a cooperating agency in preparing the EIS. The Corps was subsequently provided the opportunity for review and comment on the Plan of Study and on all work performed by the third party consultant including the Preliminary Draft EIS.

7.6 REFERENCES

Percy, G.W. 1980. Letter from George W. Percy, Deputy State Historic Preservation Officer, to A. Jean Tolman, U.S. EPA Region IV. October 14, 1980.

U.S. Environmental Protection Agency. 1980a. Letter from A. Jean Tolman, U.S. EPA Region IV, to Don Palmer U.S. Fish and Wildlife Service, Jacksonville, FL. May 9, 1980.

U.S. Environmental Protection Agency. 1980b. Letter from A. Jean Tolman, U.S. EPA Region IV, to David Peterson U.S. Fish and Wildlife Service, Jacksonville, FL. July 16, 1980.

U.S. Environmental Protection Agency. 1980c. Letter from A. Jean Tolman, U.S. EPA Region IV, to L. Ross Morell Florida Department of State, Tallahassee. July 15, 1980.

U.S. Fish and Wildlife Service. 1980a. Letter from Donald J. Hankla, U.S. Fish and Wildlife Service Jacksonville, FL, to A. Jean Tolman, U.S. EPA Region IV. May 19, 1980.

U.S. Fish and Wildlife Service. 1980b. Letter from Clayton J. Lankford, U.S. Fish and Wildlife Service, Atlanta, to A. Jean Tolman, U.S. EPA Region IV, August 19, 1980.

8.0

LIST OF PREPARERS

The Draft EIS for the Farmland project was prepared for EPA by Woodward-Clyde Consultants (WCC) of Clifton, New Jersey using the third party EIS preparation method. The names and qualifications of the WCC staff responsible for the preparation of this EIS are presented in Table 8-1. An independent evaluation of all information presented in the EIS was also performed by the following EPA officials.

Name	Responsibility
Robert B. Howard	Chief, EIS Preparation Section
A. Jean Tolman	EIS Project Officer
Lionel Alexander III	NPDES Permit Coordinator
D. Brian Mitchell	Air Quality
Doyle Brittain	Air Quality
James E. Orban	Noise
A. Eugene Coker	Geology and Groundwater
H. Richard Payne	Radiation
Curtis F. Fehn	Groundwater
Thomas R. Cavinder	Surface Water
John T. Marlar	Surface Water
William L. Kruczynski	Biology and Ecology
Delbert B. Hicks	Biology and Ecology

For information on the material presented in this section, contact A. Jean Tolman at (404)881-7458 (FTS/257-7458).

Table 8-1. NAMES, QUALIFICATIONS, AND RESPONSIBILITIES OF PERSONS WHO WERE PRIMARILY RESPONSIBLE FOR PREPARING THE FARMLAND INDUSTRIES, INC. DRAFT ENVIRONMENTAL IMPACT STATEMENT.

Name	Qualifications	Responsibility
Richard A. Millet	M.S. Civil Engineering; Principal and Vice President, Woodward-Clyde Consultants, 17 years experience including the direction of interdiscipline studies for phosphate mining projects and power plant siting projects.	Project Sponsor
Raymond L. Hinkle	M.S. Wildlife Management; Project Scientist, Woodward-Clyde Consultants; 9 years experience in the preparation of environmental impact statements for a variety of projects including phosphate mines.	Project Manager
Perry H. Fontana	M.S. Meteorology; Staff Scientist, Woodward-Clyde Consultants; 4 years experience in environmental studies involving meteorology and air quality including air quality impact assessments for phosphate rock processing operations.	Air Quality, Meteorology, and Noise
Donald R. Cannon	B.S. Geology; Project Geologist, Woodward-Clyde Consultants; 10 years experience in conducting engineering geologic investigations and groundwater studies for projects including phosphate mining operations.	Geology
Ralph E. Luebs	Ph.D. Soil Fertility; Agronomist, Woodward-Clyde Consultants; 33 years experience including the planning of and interpretation of results from soils investigations for evaluating the impact of mining on the environment and for reclamation of surface mined land.	Soils
Leland H. Bonney	M.S. Physical Chemistry; Radiological Chemist, Woodward-Clyde Consultants; 31 years experience in radiochemistry, nuclear chemistry, ion exchange, trace element analyses, and the evaluation of environmental hazards of radioactive materials.	Radiation
John C. Halepaska	Ph.D. Geoscience; Senior Hydrologist, Woodward-Clyde Consultants; 18 years experience in the study of various phases of groundwater hydrology including the theory and control of seepage from earth tailings dams, earth water retention dams, and gypsum fields at phosphate fertilizer plants.	Hydrology
Gary G. Kaufman	M.S. Environmental Engineering; Senior Staff Engineer, Woodward-Clyde Consultants; 9 years experience including the evaluation of potential water quality effects of solid and hazardous waste disposal.	Water Quality
Thomas G. Campbell	M.S. Marine Sciences; Staff Scientist, Woodward-Clyde Consultants; 6 years experience in the collection and analysis of data from aquatic environments as well as impact analysis.	Aquatic Ecology
Wayne F. MacCallum	M.S. Wildlife Management; Senior Project Scientist, Woodward-Clyde Consultants; 9 years experience in the collection and analysis of data from terrestrial environments and impact analyses for a variety of projects.	Terrestrial Ecology
Milton G. Carter	M.C.R.P. City and Regional Planning; Staff Scientist, Woodward-Clyde Consultants; 3 years experience in evaluating socioeconomics impacts for both large and small scale industrial developments.	Socioeconomics
Robert F. Brewer	Ph.D. Horticulture and Soil Chemistry; Associate Horticulturist at the University of California with 21 years experience as a consultant in the area of air pollution effects on agricultural crops, including citrus.	Citrus
Jerry J. Cape	B.S. Mining Engineering; Consulting Engineer (P.E.) with 18 years experience in minerals development projects from mining prospect data evaluations through conceptual planning, construction, and start-up.	Alternatives and Mine Plan Evaluation

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APPENDIX A
DRAFT NPDES PERMIT FOR THE FARMLAND INDUSTRIES, INC. MINE PROJECT
HARDEE COUNTY, FLORIDA

Permit No. FL0037915

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30365

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

DRAFT

In compliance with the provisions of the Clean Water Act, as amended (33 U.S.C. 1251 et. seq; the "Act"),

Farmland Industries
P. O. Box 441
Mulberry, Florida 33860

is authorized to discharge from a facility located at

about 27° 27' 54" - Latitude
81° 53' 06" - Longitude
Hardee County, Florida

to receiving waters named

DSN 001 - Hickory Creek
DSN 002 - Oak Creek

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof. The permit consists of this cover sheet, Part I ____ pages(s), Part II ____ page(s) and Part III ____page(s).

This permit shall become effective on

This permit and the authorization to discharge shall expire at midnight,

Date Signed

Howard D. Zeller
Acting Director
Enforcement Division

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 001 Clearwater Pond to Hickory Creek.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations				Monitoring Requirements	
	kg/day (lbs/day)		Other Units (Specify)			
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency (during discharge)	Sample Type
Flow—m^3/Day (MGD)	1.24	—	—	—	Continuous	Recorder
Total Suspended Solids	--	--	30 mg/1	60 mg/1	1/week	24-hr. composite
Biochemical Oxygen Demand (5-day)	--	--	2 mg/1	3 mg/1	1/week	24-hr. composite
Specific Conductance (mhos/cm @ 25°C)	--	--	550	1100	1/week	24-hr. composite
Radium*	--	--	--	--	1/week	24-hr. composite

*Combined Radium 226 & 228

The pH shall not be less than 6.0 standard units nor greater than 8.5 standard units and shall be monitored once/week during discharge with a grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): nearest accessible point after final treatment but prior to actual discharge or mixing with the receiving waters.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 002 Reclammation Area to Oak Creek

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations				Monitoring Requirements	
	kg/day (lbs/day)		Other Units (Specify)			
	Daily Avg	Daily Max	Daily Avg	Daily Max	Measurement Frequency (during discharge)	Sample Type
Flow—m³/Day (MGD)	2.51	—	—	—	Continous	Recorder
Total Suspended Solids	—	—	30 mg/1	60 mg/1	1/week	24-hr. composite
Biochemical Oxygen Demand (BOD_5) (5-day)	—	—	2 mg/1	3 mg/1	1/week	24-hr. composite
Specific Conductance (mhos/cm @ 25ºC)	—	—	550	1100	1/week	24-hr. composite
Radium	—	—	spci/1	10pci/1	1/month	24-hr. composite

*Combined Radium 226 & 228

The pH shall not be less than 6.0 standard units nor greater than 8.5 standard units and shall be monitored once/week during discharge with a grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): nearest accessible point after final treatment but prior to actual discharge or mixing with the receiving waters.

A-3

The flow in Hickory Creek must be at least 1.8 times the discharge flow to the creek.

The flow in Oak Creek must be at least 1.6 times the discharge flow to the creek.

Any overflow from facilities designed, constructed, and maintained to contain or treat the volume of wastewater which would result from a 10-year, 24-hour precipitation event shall not be subject to the suspended solids effluent limitation or the pH limitations listed on the preceding page. Monitoring and reporting shall be required for all the parameters including TSS and pH.

The effluent limits and any additional requirements specified in the attached certification supersede any less stringent effluent limits listed above. During any time period in which more stringent state certification effluent limits are stayed or inoperable, the effluent limits listed above shall be in effect and fully enforceable.

2. DEFINITIONS

The term "10-year, 24-hour precipitation event" shall mean the maximum 24-hour precipitation event with a probable re-occurrence interval of once in 10 years. This information is available in "Weather Bureau Technical Paper No. 40, May 1961 and may be obtained from the Environmental Data Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

B. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

   a. Permittee shall comply with the effluent limitations by the effective date of the permit.

   b. This permit shall be modified, or alternatively, revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under sections 301(b)(2) (C), (D), (E), and (F), 304(b)(2), and 307(a)(2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:

      (1) Contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or
      (2) Controls any pollutant not limited in the permit.

   The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

2. No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

A. MANAGEMENT REQUIREMENTS

1. Discharge Violations

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant more frequently than, or at a level in excess of, that identified and authorized by this permit constitutes a violation of the terms and conditions of this permit. Such a violation may result in the imposition of civil and/or criminal penalties as provided in Section 309 of the Act.

2. Change in Discharge

Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants must be reported by submission of a new NPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the permit issuing authority of such changes. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

3. Noncompliance Notification

a. Instances of noncompliance involving toxic or hazardous pollutants should be reported as outlined in Condition 3c. All other instances of noncompliance should be reported as described in Condition 3b.

b. If for any reason, the permittee does not comply with or will be unable to comply with any discharge limitation specified in the permit, the permittee shall provide the Permit Issuing Authority with the following information at the time when the next Discharge Monitoring Report is submitted.

   (1) A description of the discharge and cause of noncompliance;
   (2) The period of noncompliance, including exact dates and times and/or anticipated time when the discharge will return to compliance; and
   (3) Steps taken to reduce, eliminate, and prevent recurrence of the noncomplying discharge.

c. Toxic or hazardous discharges as defined below shall be reported by telephone within 24 hours after permittee becomes aware of the circumstances and followed up with information in writing as set forth in Condition 3b. within 5 days, unless this requirement is otherwise waived by the Permit Issuing Authority:

(1) Noncomplying discharges subject to any applicable toxic pollutant effluent standard under Section 307(a) of the Act;
(2) Discharges which could constitute a threat to human health, welfare or the environment. These include unusual or extraordinary discharges such as those which could result from bypasses, treatment failure or objectionable substances passing through the treatment plant. These include Section 311 pollutants or pollutants which could cause a threat to public drinking water supplies.

d. Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

4. Facilities Operation

All waste collection and treatment facilities shall be operated in a manner consistent with the following:

a. The facilities shall at all times be maintained in a good working order and operated as efficiently as possible. This includes but is not limited to effective performance based on design facility removals, adequate funding, effective management, adequate operator staffing and training, and adequate laboratory and process controls (including appropriate quality assurance procedures); and

b. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Permit Issuing Authority.

c. The permittee, in order to maintain compliance with this permit shall control production and all discharges upon reduction, loss, or failure of the treatment facility until the facility is restored or an alternative method of treatment is provided.

5. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to waters of the United States resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature of the noncomplying discharge.

6. Bypassing

"Bypassing" means the intentional diversion of untreated or partially treated wastes to waters of the United States from any portion of a treatment facility. Bypassing of wastewaters is prohibited unless all of the following conditions are met:

a. The bypass is unavoidable-i.e. required to prevent loss of life, personal injury or severe property damage;

b. There are no feasible alternatives such as use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment down time;

c. The permittee reports (via telephone) to the Permit Issuing Authority any unanticipated bypass within 24 hours after becoming aware of it and follows up with written notification in 5 days. Where the necessity of a bypass is known (or should be known) in advance, prior notification shall be submitted to the Permit Issuing Authority for approval at least 10 days beforehand, if possible. All written notifications shall contain information as required in Part II (A)(3)(b); and

d. The bypass is allowed under conditions determined to be necessary by the Permit Issuing Authority to minimize any adverse effects. The public shall be notified and given an opportunity to comment on bypass incidents of significant duration to the extent feasible.

This requirement is waived where infiltration/inflow analyses are scheduled to be performed as part of an Environmental Protection Agency facilities planning project.

7. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the United States.

8. Power Failures

The permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failures either by means of alternate power sources, standby generators or retention of inadequately treated effluent. Should the treatment works not include the above capabilities at time of permit issuance, the permittee must furnish within six months to the Permit Issuing Authority, for approval, an implementation schedule for their installation, or documentation demonstrating that such measures are not necessary to prevent discharge of untreated or inadequately treated wastes. Such documentation shall include frequency and duration of power failures and an estimate of retention capacity of untreated effluent.

9. Onshore or Offshore Construction

This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or the undertaking of any work in any waters of the United States.

B. RESPONSIBILITIES

1. Right of Entry

The permittee shall allow the Permit Issuing Authority and/or authorized representatives (upon presentation of credentials and such other documents as may be required by law) to:

a. Enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit;

b. Have access to and copy at reasonable times any records required to be kept under the terms and conditions of this permit;

c. Inspect at reasonable times any monitoring equipment or monitoring method required in this permit;

d. Inspect at reasonable times any collection, treatment, pollution management or discharge facilities required under the permit; or

e. Sample at reasonable times any discharge of pollutants.

2. Transfer of Ownership or Control

A permit may be transferred to another party under the following conditions:

a. The permittee notifies the Permit Issuing Authority of the proposed transfer;

b. A written agreement is submitted to the Permit Issuing Authority containing the specific transfer date and acknowledgement that the existing permittee is responsible for violations up to that date and the new permittee liable thereafter.

Transfers are not effective if, within 30 days of receipt of proposal, the Permit Issuing Authority disagrees and notifies the current permitttee and the new permittee of the intent to modify, revoke and reissue, or terminate the permit and to require that a new application be filed.

3. Availability of Reports

Except for data determined to be confidential under Section 308 of the Act, (33 U.S.C. 1318) all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the State water pollution control agency and the Permit Issuing Authority. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Act (33 U.S.C. 1319).

4. Permit Modification

After notice and opportunity for a hearing, this permit may be modified, terminated or revoked for cause (as described in 40 CFR 122.15 et seq) including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts;

c. A change in any condition that requires either temporary interruption or elimination of the permitted discharge; or

d. Information newly acquired by the Agency indicating the discharge poses a threat to human health or welfare.

If the permittee believes that any past or planned activity would be cause for modification or revocation and reissuance under 40 CFR 122.15 et seq, the permittee must report such information to the Permit Issuing Authority. The submission of a new application may be required of the permittee.

5. Toxic Pollutants

   a. Notwithstanding Part II (B)(4) above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge authorized herein and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revoked and reissued or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

   b. An effluent standard established for a pollutant which is injurious to human health is effective and enforceable by the time set forth in the promulgated standard, even though this permit has not as yet been modified as outlined in Condition 5a.

6. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing", Part II (A) (6), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

7. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act (33 U.S.C. 1321).

8. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

10. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

11. Permit Continuation

A new application shall be submitted at least 180 days before the expiration date of this permit. Where EPA is the Permit Issuing Authority, the terms and conditions of this permit are automatically continued in accordance with 40 CFR 122.5, provided that the permittee has submitted a timely and sufficient application for a renewal permit and the Permit Issuing Authority is unable through no fault of the permittee to issue a new permit before the expiration date.

C. MONITORING AND REPORTING

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Reporting

Monitoring results obtained during each calendar month (quarter if monitoring frequency is quarterly) shall be summarized for each month (quarter) and reported on a Discharge Monitoring Report Form (EPA No. 3320-1). Forms shall be submitted at the end of each calendar quarter and shall be postmarked no later than the 28th day of the month following the end of the quarter. The first report is due by the 28th day of the month following the first full quarter after the effective date of this permit.

Signed copies of these, and all other reports required herein, shall be submitted to the Permit Issuing Authority at the following address(es):

Compliance Branch Environmental Protection Agency Region IV 345 Courtland Street, N.E. Atlanta, Georgia 30365	FL Dept. of Environmental Regulation Division of Environmental Programs Twin Towers Office Building 2600 Blair Stone Road Tallahassee, Florida 32301

3. Test Procedures

Test procedures for the analysis of pollutants shall conform to all regulations published pursuant to Section 304(h) of the Clean Water Act, as amended (40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants").

4. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

a. The exact place, date, and time of sampling;

b. The person(s) who obtained the samples or measurements;

c. The dates the analyses were performed;

d. The person(s) who performed the analyses;

e. The analytical techniques or methods used; and

f. The results of all required analyses.

5. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report Form (EPA No. 3320-1). Such increased frequency shall also be indicated.

6. Records Retention

The permittee shall maintain records of all monitoring including: sampling dates and times, sampling methods used, persons obtaining samples or measurements, analyses dates and times, persons performing analyses, and results of analyses and measurements. Records shall be maintained for three years or longer if there is unresolved litigation or if requested by the Permit Issuing Authority.

D. DEFINITIONS

1. Permit Issuing Authority

The Regional Administrator of EPA Region IV or designee.

2. Act

"Act" means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act) Public Law 92-500, as amended by Public Law 95-217 and Public Law 95-576, 33 U.S.C. 1251 et seq.

3. Mass/Day Measurements

a. The "average monthly discharge" is defined as the total mass of all daily discharges sampled and/or measured during a calendar month on which daily discharges are sampled and measured, divided by the number of daily discharges sampled and/or measured during such month. It is, therefore, an arithmetic mean found by adding the weights of the pollutant found each day of the month and then dividing this sum by the number of days the tests were reported. This limitation is identified as "Daily Average" or "Monthly Average" in Part I of the permit and the average monthly discharge value is reported in the "Average" column under "Quantity" on the Discharge Monitoring Report (DMR).

b. The "average weekly discharge" is defined as the total mass of all daily discharges sampled and/or measured during a calendar week on which daily discharges are sampled and/or measured divided by the number of daily discharges sampled and/or measured during such week. It is, therefore, an arithmetic mean found by adding the weights of pollutants found each day of the week and then dividing this sum by the number of days the tests were reported. This limitation is identified as "Weekly Average" in Part I of the permit and the average weekly discharge value is reported in the "Maximum" column under "Quantity" on the DMR.

c. The "maximum daily discharge" is the total mass (weight) of a pollutant discharged during a calendar day. If only one sample is taken during any calendar day the weight of pollutant calculated from it is the "maximum daily discharge". This limitation is identified as "Daily Maximum," in Part I of the permit and the highest such value recorded during the reporting period is reported in the "Maximum" column under "Quantity" on the DMR.

4. Concentration Measurements

a. The "average monthly concentration," other than for fecal coliform bacteria, is the concentration of all daily discharges sampled and/or measured during a calendar month on which daily discharges are sampled and measured divided by the number of daily discharges sampled and/or measured during such month (arithmetic mean of the daily concentration values). The daily concentration value is equal to the concentration of a composite sample or in the case of grab samples is the arithmetic mean (weighted by flow value) of all the samples collected during that calendar day. The average monthly count for fecal coliform bacteria is the geometric mean of the counts for samples collected during a calendar month. This limitation is identified as "Monthly Average" or "Daily Average" under "Other Limits" in Part I of the permit and the average monthly concentration value is reported under the "Average" column under "Quality" on the DMR.

b. The "average weekly concentration," other than for fecal coliform bacteria, is the concentration of all daily discharges sampled and/or measured during a calendar week on which daily discharges are sampled and measured divided by the number of daily discharges sampled and/or measured during such week (arithmetic mean of the daily concentration values). The daily concentration value is equal to the concentration of a composite sample or in the case of grab samples is the arithmetic mean (weighted by flow value) of all samples collected during that calendar day. The average weekly count for fecal coliform bacteria is the geometric mean of the counts for samples collected during a calendar week. This limitation is identified as "Weekly Average" under "Other Limits" in Part I of the permit and the average weekly concentration value is reported under the "Maximum" column under "Quality" on the DMR.

c. The "maximum daily concentration" is the concentration of a pollutant discharged during a calendar day. It is identified as "Daily Maximum" under "Other Limits" in Part I of the permit and the highest such value recorded during the reporting period is reported under the "Maximum" column under "Quality" on the DMR.

5. Other Measurements

   a. The effluent flow expressed as M^3/day (MGD) is the 24 hour average flow averaged monthly. It is the arithmetic mean of the total daily flows recorded during the calendar month. Where monitoring requirements for flow are specified in Part I of the permit the flow rate values are reported in the "Average" column under "Quantity" on the DMR.

   b. Where monitoring requirements for pH, dissolved oxygen or fecal coliform are specified in Part I of the permit the values are generally reported in the "Quality or Concentration" column on the DMR.

6. Types of Samples

   a. Composite Sample - A "composite sample" is any of the following:

      (1) Not less than four influent or effluent portions collected at regular intervals over a period of 8 hours and composited in proportion to flow.

      (2) Not less than four equal volume influent or effluent portions collected over a period of 8 hours at intervals proportional to the flow.

      (3) An influent or effluent portion collected continuously over a period of 24 hours at a rate proportional to the flow.

   b. Grab Sample: A "grab sample" is a single influent or effluent portion which is not a composite sample. The sample(s) shall be collected at the period(s) most representative of the total discharge.

7. Calculation of Means

   a. Arithmetic Mean: The arithmetic mean of any set of values is the summation of the individual values divided by the number of individual values.

   b. Geometric Mean: The geometric mean of any set of values is the $N^{\underline{th}}$ root of the product of the individual values where N is equal to the number of individual values. The geometric mean is equivalent to the antilog of the arithmetic mean of the logarithms of the individual values. For purposes of calculating the geometric mean, values of zero (0) shall be considered to be one (1).

c. **Weighted by Flow Value:** Weighted by flow value means the summation of each concentration times its respective flow divided by the summation of the respective flows.

8. Calendar Day

a. A calendar day is defined as the period from midnight of one day until midnight of the next day. However, for purposes of this permit, any consecutive 24-hour period that reasonably represents the calendar day may be used for sampling.

National Environmental Policy Act (NEPA) Requirements

The below listed requirements, conditions and limitations were recommended in the Farmland Industries Phosphate Mine site specific Environmental Impact Statement, and are hereby incorporated into National Pollutant Discharge Elimination System Permit No. FL0037915 in accordance with 40 CFR 122.62(d)(9).

1. Farmland shall exclude the utilization of any conventional aboveground slime-disposal areas with the exception of Clay Settling areas I and II described in the EIS. Farmland's waste disposal and reclamation plan shall employ a sand-clay mix process as described in the EIS. Only Settling Area II shall remain active for the life of the mine.

2. Farmland shall perform the dragline mining operation in a fashion that increases the casting distance of the overburden, causing the overburden to be piled higher and thereby increasing by approximately 10 percent the below ground volume available for waste disposal and lowering the above ground profile of Settling Area II by approximately four feet.

3. Farmland shall meet the requirements of its Southwest Florida Water Management District (SWFWMD) Consumptive Use Permit.

4. Farmland shall provide storage that allows recirculation of water recovered from slimes. The water circulation system and storage capacity shall be as described in the EIS for Farmland's proposed project.

5. During the dragline mining activity, Farmland shall employ the technique of leach zone management by toe spoiling, i.e., overburden from near the interface with the matrix (the leach zone, where radioactivity in the overburden is concentrated) shall be placed at the toe of the spoil pile and covered with overburden from upper strata.

6. Farmland shall meet county and state reclamation requirements.

7. Farmland shall preserve from mining, or any other disturbance, the areas proposed for preservation in Farmland's proposed action in the EIS. These areas are depicted in the attached map, Figure 1. Specifically, the total preserved acreage of 2530 acres shall include a minimum of 510 acres of forested uplands, 885 acres of freshwater swamp, 107 acres of freshwater marsh, and 354 acres of pine flatwoods/palmetto range, all in the locations depicted in Figure 1.

8. Farmland shall increase the acreage reclaimed as forest habitat and provide corridors for wildlife movement between reclaimed and preserved areas by planting additional areas as depicted in Figure 2, attached.

9. Farmland shall incorporate into its reclamation plan a littoral zone at the downstream extent of the proposed reclaimed open lake in the Hickory Creek channel. This littoral zone shall be at least 500 feet wide and at a depth suitable for emergent vegetation, providing for the establishment of 7-10 acres of marsh community.

10. Before beginning any land-disturbing activities, Farmland shall develop a program whereby indigo snakes encountered in the work area are captured for relocation to other areas of suitable habitat in the site region. This program shall include informing Farmland workers of the importance of the indigo snake, familiarizing them with its appearance and instructing them as to its preservation. In addition, the gopher tortoise population shall be protected to the extent possible in the site area. Farmland shall coordinate its recovery and relocation efforts with the Florida Endangered Species Coordinator, and shall maintain a record of the program to be submitted to the U.S. Fish and Wildlife Service.

11. Farmland shall comply with the categorization of wetlands present on the mine property as set forth in the EIS and illustrated in Figure 3, attached. In summary, within Category 1 wetlands, Farmland shall not mine, shall limit activities to those essential to and unavoidable for the mining operation, and shall otherwise take all reasonable measures to preserve all Category 1 wetlands. Additionally, Farmland shall restore the total acreage of Category 2 wetlands disturbed by mining. Specifically, the acreage to be restored as freshwater marsh or swamp according to Farmland's proposed action in the EIS shall be increased by at least 116 acres (from 398 acres to a minimum of 514 acres). This shall be done by differential grading and settling of sand-clay mix areas in addition to that already proposed by Farmland in the EIS.

12. During the mining of the unpreserved portion of Hickory Creek, the flow from this area shall be diverted around the active mine area into the lower preserved section of Hickory Creek (rather than to Troublesome Creek).

13. Mining in the vicinity of lower Hickory Creek shall be scheduled such that open mine pits exist adjacent to only one side of the preserved portion of the creek at a given time.

14. Farmland shall monitor the water quality of the Surficial Aquifer at the location identified on the attached map, Figure 3. The following parameters shall be monitored on a quarterly basis for the life of the mine: pH, specific conductance, sulfates, fluoride, and ammonia. A written report summarizing the data shall be submmitted once a year to EPA.

15. Unless specified otherwise by a preceding condition in this permit, Farmland shall carry out its mining project in complete accordance with the applicant's proposed action described and evaluated in the Farmland EIS, including the employment of all mitigating measures presented as part of the proposed action. However, this shall not preclude the imposition of any additional or more stringent conditions which may be required by any local or state regulatory agency or governmental entity.

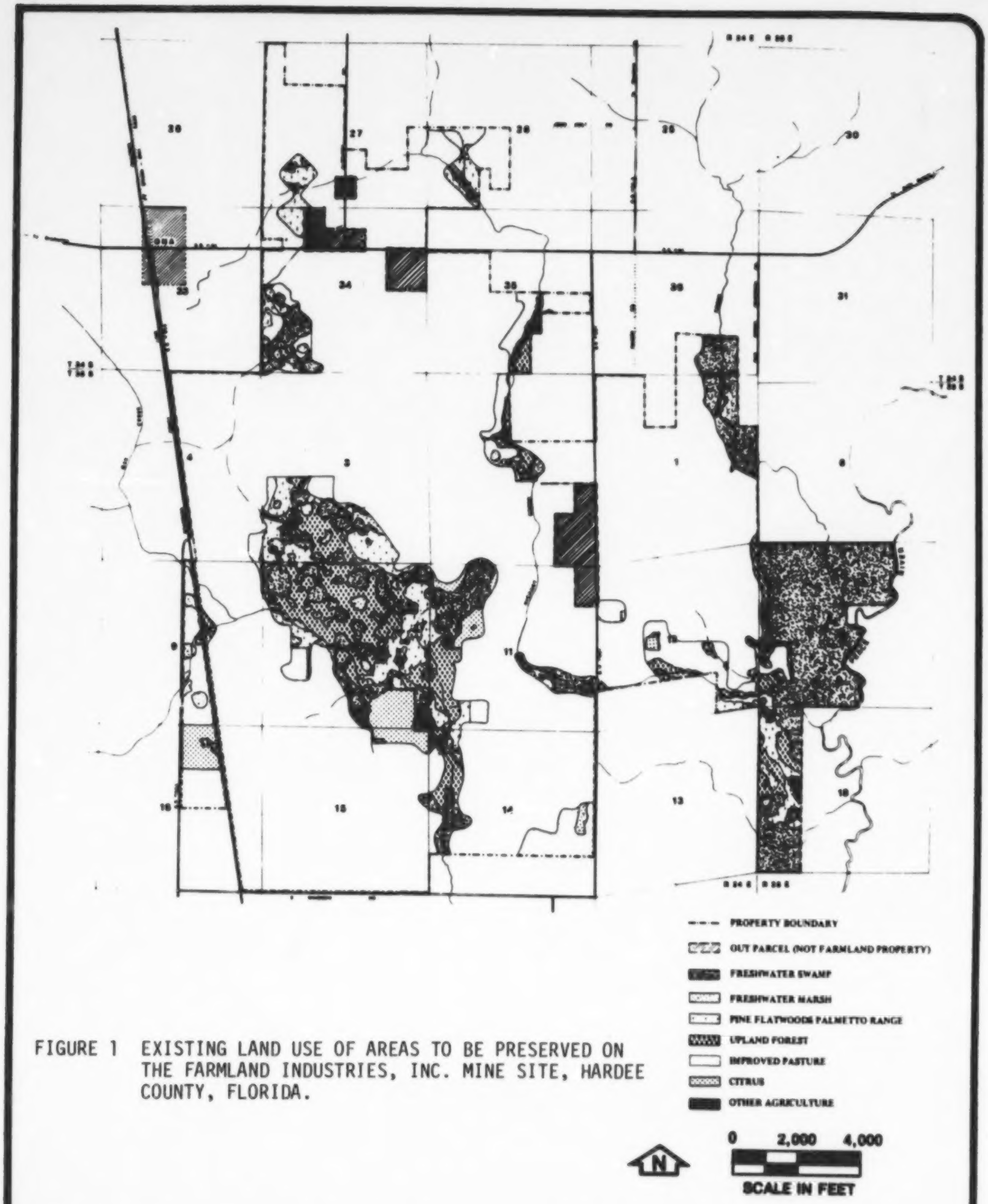

FIGURE 1 EXISTING LAND USE OF AREAS TO BE PRESERVED ON THE FARMLAND INDUSTRIES, INC. MINE SITE, HARDEE COUNTY, FLORIDA.

SOURCE: FARMLAND INDUSTRIES, INC., HARDEE COUNTY MASTER PLAN, JUNE 1979

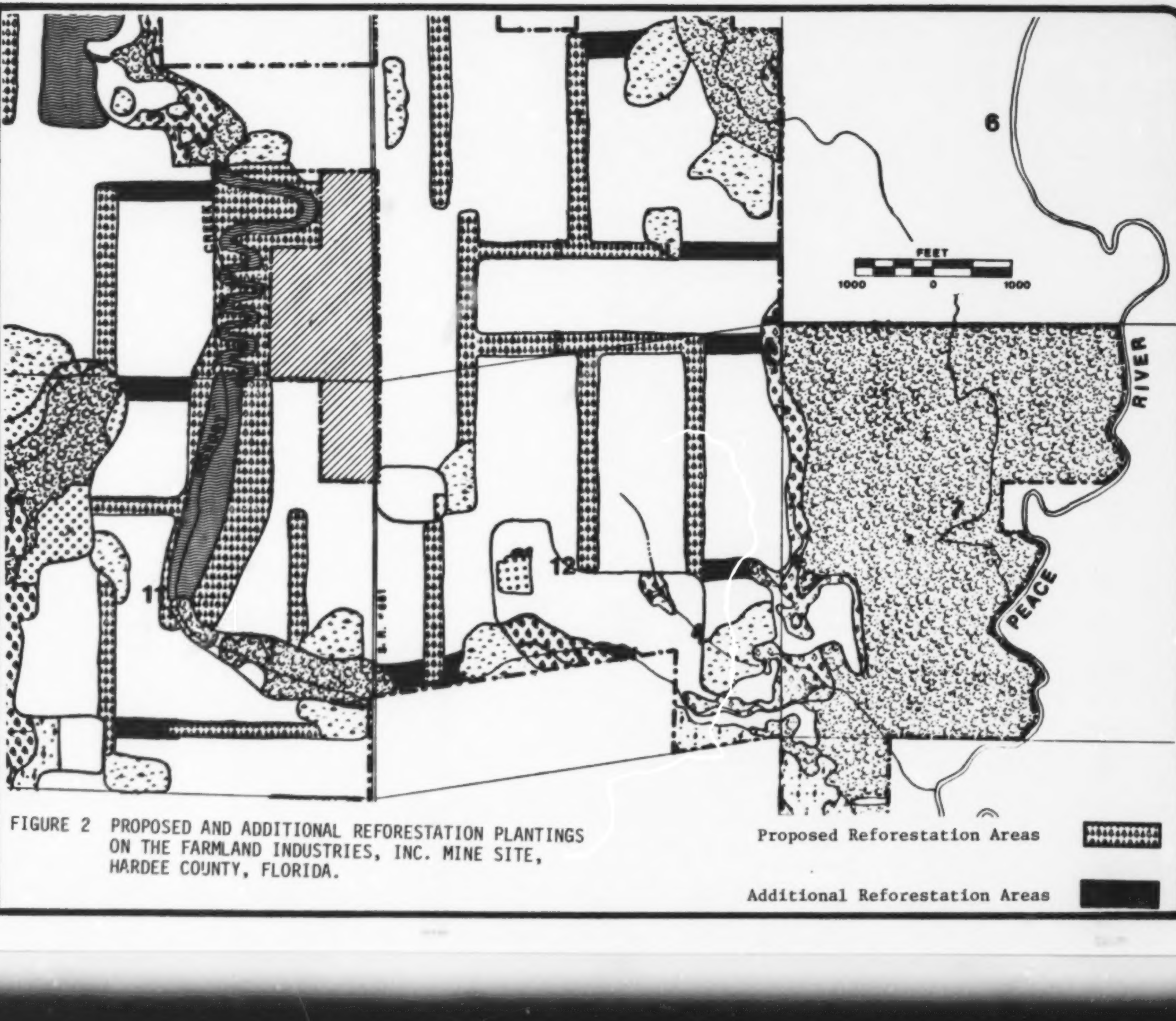

FIGURE 2 PROPOSED AND ADDITIONAL REFORESTATION PLANTINGS ON THE FARMLAND INDUSTRIES, INC. MINE SITE, HARDEE COUNTY, FLORIDA.

Proposed Reforestation Areas ▦

Additional Reforestation Areas ■

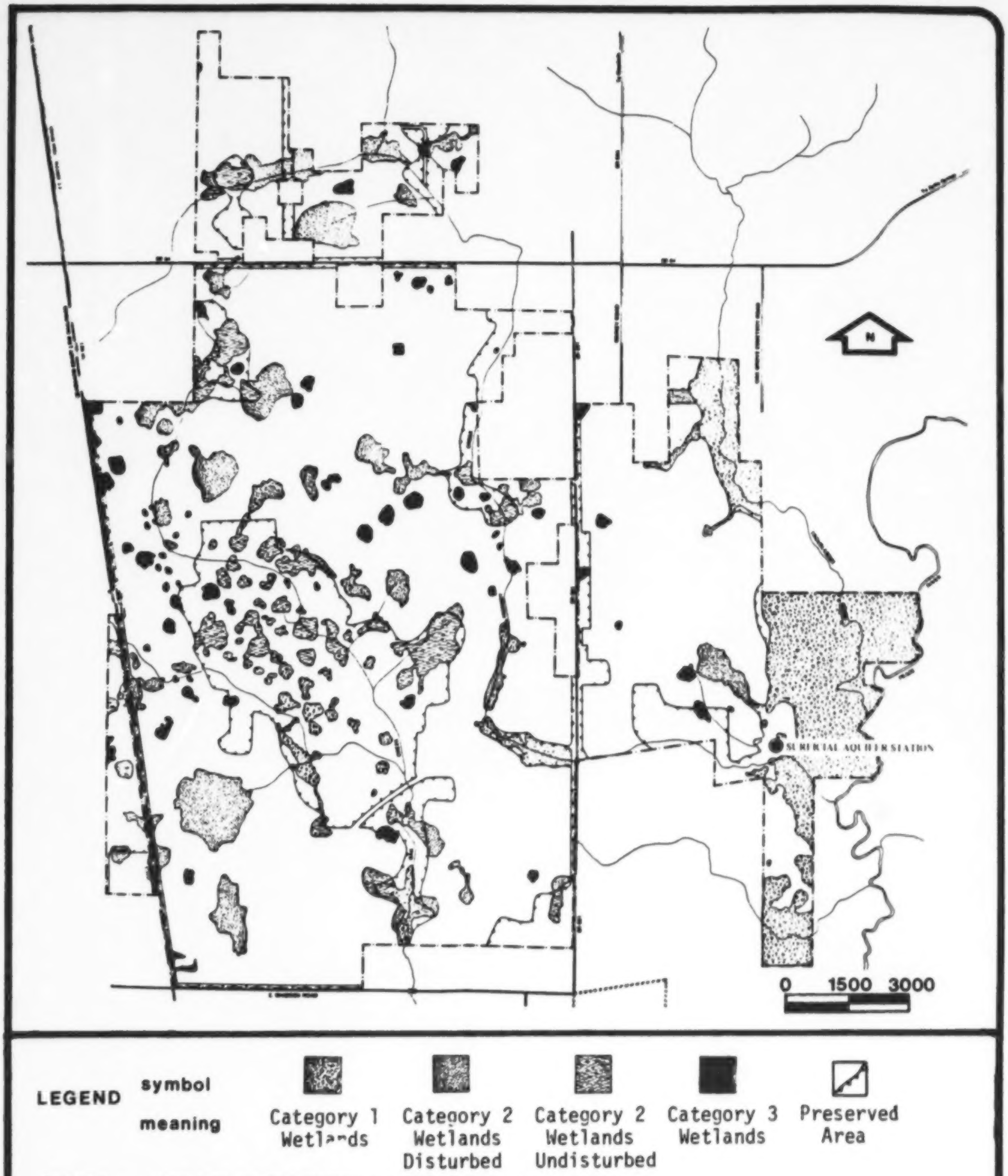
SURFICIAL AQUIFER STATION
N
0 1500 3000
LEGEND
symbol
meaning
Category 1 Wetlands
Category 2 Wetlands Disturbed
Category 2 Wetlands Undisturbed
Category 3 Wetlands
Preserved Area

FIGURE 3 WETLAND CATEGORIZATION AND SURFICIAL AQUIFER MONITORING LOCATION, FARMLAND INDUSTRIES, INC. SITE, HARDEE COUNTY, FLORIDA.

SOURCE: **WOODWARD-CLYDE CONSULTANTS (1980)**